Gas Journal

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Editorial Notes

Smokeless Solid Fuel

One of the claims made by supporters of low-temperature carbonization is that it will enhance the value of low-grade coal and so allow of a good price being realized for this material. The coal they usually have in mind has a high percentage below ¼ in. and contains 8 to 12% of ash. The smokeless fuel made from such coal would contain anything from 11 to 16% ash and would not be an acceptable proposition from the householder's point of view. This point was emphasized by the "Oil from Coal" Committee of the Scottish National Development Association in their First Report published two years ago and discussed in the "Journal" for July 31, 1935. The conclusion was then expressed that, instead of a smokeless fuel being derived from low-grade coal, an especially high-grade coal would be required if the semi-coke was ever to be a formidable competitor of good house coal in a free market. At that time the Committee put forward the following recommendations: If the coal as charged is of a size not smaller than 1¾ in. an ash percentage may be allowed up to about 4·5% in the semi-coke, or rather more than 3% in the coal. If the coal as charged is of a size smaller than 1¾ in. the ash in the semi-coke should not exceed 3·5%, or about 2·5% in the coal. The Committee then set about to gain definite information on the demand for smokeless fuel in Scotland, appointing for this purpose a special Sub-Committee to investigate the problem thoroughly.

The "Oil from Coal" Committee have now issued their Third Report (Revised) which contains the findings of this investigation. In Scotland two classes of coal are available for low-temperature carbonization processes, semi-coking and non-coking, and the first step taken was to select suitable coals from these classes for large-scale test. It is significant that, of the 67 members of the Coalmasters' Association in Fife, the Lothians, and Lanarkshire circularized in regard to the supply of non-coking or weakly coking coals, only four offered coals, seven in number, which complied or nearly complied with the Committee's specification as to ash content to which we have just referred. From each of these three districts a coal was selected for test, 100 tons of each variety being supplied for treatment at the plant operated by British Coal Distillation at Ashby-de-la-Zouch. A consignment of Ayrshire coking coal, 300 tons in amount, was supplied for treatment at the Barugh Works of Low Temperature Carbonisation, Ltd. Trouble was experienced in carbonizing the coals at both plants. At Barugh swelling of the coal in the retorts rendered discharge of the coke extremely difficult, and it is obvious that resort would have to be made to blending. The Committee are at pains to emphasize, however, the fact that the report deals with Scottish conditions only, and state that they consider "any reference made in the report to difficulties encountered in the treatment of Pennyvenie coal in the plant of Messrs. Low Temperature Carbonisation, Ltd., in no way reflects on its efficiency in the treatment of other coals, or coal blends, suitable for carbonization in this plant." The difficulties at the plant of British Coal Distillation, Ltd., are attributed in part to the fact that the operators were dealing with unfamiliar coals. However, these difficulties are minor to the broad issue of the report; and it is with the broad issues that we are concerned here.

Price and Demand

The next step in the investigation was to distribute the solid smokeless fuels made at Barugh and Ashby-de-la-Zouch in various districts in Scotland in order to ascertain the market value and demand of these fuels. The coal merchants who received supplies of the test fuels were asked to encourage the testing of the fuels by as many consumers as possible, including not only those who normally burn the best quality of household coal, but also those accustomed to burning the lower grades. The merchants, working on the reactions of their consumers to these fuels, were asked to indicate the price they would be prepared to pay for each type of fuel delivered at their depôts and which would enable them to market the fuels if they were available in large quantities. As an example of the way the investigation was conducted, one merchant's estimate of the value of one of the fuels is based on the reactions of over 200 consumers, and another merchant's on the reports made by over 100

consumers. From the comments made by consumers it seems clear that only coals of high quality can be used in the manufacture by low-temperature carbonization of smokeless solid fuels for which there would be any extensive demand, and as a result of the investigation the Committee state definitely that none of the smokeless fuels can be produced at an economic figure under present-day conditions. Only in the case of two of the test fuels could the briquettes or the semi-coke be produced at a plant situated at a colliery at a cost less than the price at which the merchants estimate they could pay for the smokeless fuels delivered in their depôts. With the railway freight added, the cost of production is in every case greater than the merchants are willing to pay for the smokeless fuel if it were delivered in large quantities.

One of the members of the Committee was the Duke of Montrose, who is a Director of British Coal Distillation, Ltd., and in a supplementary statement to the report he explains that, though he has agreed that his name shall appear along with those of others who have signed the report, in his opinion some of the statements made are prejudiced and misleading. The steps taken by the Committee to find an economic market in Scotland for smokeless fuel were, he maintains, ridiculous. "Coal merchants," he remarks, "were invited at the very end of the winter season to indicate what prices they would like to give for small parcels of smokeless fuel delivered into their yards, and obviously they stated the lowest figure possible. If the Coalmasters sold their own coal on this principle there would at once be a wonderful reduction in the price of household fuel. It would have been much more appropriate if the Committee had fixed an economic figure—say, 45s. a ton—and offered to deliver parcels into the yards of the merchants at that price, and then have observed the clearance of the fuel. As a matter of fact, the smokeless fuel was in a number of cases disposed of by the merchants to consumers at prices ranging between 54s. and 60s. a ton. Nothing is said in the report about repeat orders, although it is known that the merchants received quite a number which they could not fulfil, because there is no plant in Scotland able to give the supply. . . . In actual fact the Committee have wandered far beyond the terms of their remit, and although many of the members can claim to wide experience, and much scientific knowledge on the subject of coal, they have failed completely to put forward one single suggestion towards overcoming any of the difficulties they have imagined." There is also a supplementary statement to the report by Councillor W. Brownhill Smith, another member of the Committee, in which he dissociates himself from the Committee's conclusions.

"Several thousands of tons," states the report, "represent the output of an economically sized plant for only two or three weeks. Even allowing for some unsaturation, at the present time, of the Scottish market for smokeless fuel, if something of the order of 100,000 tons per annum of such a fuel were available for sale, the fuel would have to make a market for itself by displacing household coal, and so would only fetch the price obtained for this." In this statement obviously the Committee take no account of the higher efficiency of smokeless fuel and the savings which must accrue from its use on account of its smokelessness; and, of course, the figures of cost are all estimates and they apply solely to plants situated at collieries in Scotland. The document does make dismal reading for wholesale low-temperature carbonization effected at Scottish collieries, and we think that it is inclined to overlook the growing demand for smokelessness. Nor, as the Committee remark, has consideration been given to the production of domestic smokeless fuels by low, medium, or high-temperature carbonization at gas-works. This is quite another aspect of the matter. In regard to low-temperature carbonization the plant of the South Metropolitan Gas Company is a proved commercial proposition and Metro-Coalite is being sold at a profit. Moreover, the demand for this smokeless fuel is for the most part in the homes of the less well-to-do. Work at Liverpool has shown that the Gas Industry can provide fuel for the domestic grate which is smokeless, easily ignited, which will radiate more heat than raw coal, and which is in every way satisfactory to the consumer. This coke is being sold at the same price as that of good coal and it finds a ready sale. Then there is the gas ignited coke grate, which is an exceedingly economical and thoroughly efficient appliance for burning graded high-temperature coke. The Report of the "Oil from Coal" Committee demonstrates that it is to the Gas Industry that the public must look for the greatest contribution to smoke abatement and the rational treatment of raw coal.

Forty Years of Activity

It must be confessed that there is no particular magic about the simple word "forty," and that, taken without any context, there is not even anything very impressive suggested by it. But at one time, at any rate, it did acquire a certain significance for those whose hair was commencing to thin upon the temples, by the introduction of a phrase, which was destined to degenerate into a tag: "Too old at forty." Now, whether there was ever, in any circumstances whatever, any real justification for the saying we have often felt inclined to doubt, but even if this inclination may, in certain special cases, carry us beyond the limits of scrupulous accuracy, we can assert with perfect safety that no such accusation of diminished value can truthfully be levelled against the Gas Companies' Protection Association, the proceedings at whose Annual General Meeting (reported elsewhere in this issue of the "Journal") reveal the expiration of forty years of active work in the Gas Industry.

On the contrary, the Association is in the full vigour of a life spent in the gathering of knowledge and the gaining of experience which must render each year of work more valuable to the members than those that preceded it. True it is that, with the passing of time, the problems confronting the Industry are found to change, but the best help in the present, the surest guide for the future, may most reasonably be sought in a sound knowledge of the past. For this one fact alone—were there nothing else to be urged in its favour—we would sincerely wish continued prosperity to the Gas Companies' Protection Association. But there is the additional consideration that all this knowledge and experience have been acquired from one particular angle of the Industry, which may logically be presumed to endow the work of the Association with a value of its own.

Unhappily, the Chairman, Mr. R. W. Edwards, was prevented by indisposition from being present at the meeting, but he had prepared for the occasion an exhaustive Address, which was read by Mr. F. G. Brewer, Vice-Chairman of the Committee. A great deal of the work done by, and on behalf of, the Association—indeed, the principal portion—may be regarded as being more or less of a personal nature, and the close of a busy period called for, and received, suitable recognition of the efforts of those who had laboured in the Association field. Readers

who can recall the details which in former years were sometimes given at meetings by his father, the late Mr. F. E. Cooper, will be aware of the diversified character of the advice which Mr. R. Girdlestone Cooper, the present Secretary, is called upon to give to gas companies, while the Address of the Chairman reveals the widespread activities of the past year. Further than this, as the Chairman pointed out, mentioning a few names, altogether distinct from the actual time and labour involved on the part of those members who serve directly on the Committee there are a number of gentlemen who devote their time and their talents to serving on various Boards, Councils, Associations, and Committees on which the Gas Companies' Protection Association have a representation.

A glance at the Chairman's Address is sufficient to enable one to understand not only the importance of the work that has been done, but the need for unrelaxed effort in accomplishing what remains to be done. Thus, in making their organization an indispensable link in the structure of the Gas Industry, those responsible for the activities of the Gas Companies' Protection Association have shouldered a responsibility which we know they will always be not merely ready, but anxious, to bear.

Weston-super-Mare

LAST week we described in some detail the new carbonizing plant which was inaugurated at Weston-super-Mare on Dec. 1. We are now able to testify to the quite exceptional interest which the Gas Industry took in this new unit, as evidenced especially by the gathering in Weston to see the plant officially started up by Sir Harold Hartley, C.B.E., M.C. The attendance of the President and one Vice-President of The Institution of Gas Engineers, in addition to gas engineers from all parts of the country, must have given particular pleasure to Mr. J. Taylor not only as an Engineer who has successfully faced up to somewhat unusual engineering problems, but also as organizer, with the help of an enthusiastic staff, of one of the most interesting and well arranged works visits of recent times. Messrs. Woodall-Duckham, too, must have been highly gratified at the many congratulations they received upon the new plant, and the very great interest displayed in the novel features which it incorporates.

Among the considerations which led to the choice of intermittent vertical chambers—and the new plant has many outstanding features—were labour cost and the fact that such plant could deal with all types of coal, yielding satisfactory outputs of gas and at the same time a coke of a quality similar to that to which the Company's consumers were accustomed. Particularly important was the question of foundations, the site conditions presenting a problem of much difficulty. It was a problem which called for special care not merely in choice of plant but in its disposition. Our account in the "JOURNAL" last week of how these difficulties were surmounted will have been read with the greatest interest; and the measure of engineering skill brought to bear in the erection of the plant will be generally appreciated. It was emphasized at the inspection by a striking visual demonstration of the irregular settlement of the old horizontals house, amounting in places to as much as 23 in. below the original level.

A noteworthy feature of this new W.-D. installation of intermittent chambers is that advantage has been taken of the technique developed in connection with continuous vertical retorts of dispensing with recuperators and obtaining a greater recovery of steam from the waste gases. Elimination of the recuperators from the Weston plant enabled the load to be spread over a bigger area by building the producers separately from the setting. To the best of our knowledge these are the first large capacity chambers to be designed for non-recuperative heating. The maximum daily capacity of the plant, which consists of fifteen chambers, is 109 tons of coal giving a gas yield of about 1,560,000 cu.ft., and the battery of three producers is arranged at floor level at one side of the bench. Any producer can be shut down without interfering with the working of the other producers, and the grate area is such that breeze can be used. The producers are operating on a mixture of coke and breeze, and the overall thermal and economic efficiency of the plant—considered as a carbonizing unit and a steam raising installation—shows an improvement. The whole of the steam required for the chambers, producers, and steam driven units is generated in the waste heat boiler, and there is a considerable surplus available for other works purposes.

We would call attention, too, to the comprehensive coke handling and screening plant. Coke from the chambers is fed to a scalping screen which removes all coke below $1\frac{3}{4}$ in. This portion is conveyed back to the retort house and delivered either to the producer coke hopper or the chamber coke hopper as needed. The remainder of the coke, naturally of a higher saleable value, is passed on to the cutting and screening plant, and is graded into five sizes. The arrangements for storage and loading are excellent; and in regard to this aspect of coke preparation for the market, another noteworthy feature of this modern installation is that provision is made for coal blending in the future.

Forthcoming Engagements

Dec.

9.—I.G.E.—Gas-Works Safety Rules Committee, Gas Industry House, 2.30 p.m.

9.—SOUTHERN ASSOCIATION (EASTERN DISTRICT).—Meeting at Gas Industry House, 2.30 p.m. Discussion "Re-Organization of Maintenance Service at Brighton."

11.—WESTERN JUNIORS.—Visit to Trowbridge Gas-Works. Paper by V. J. Borrett on "Works Extensions at Trowbridge."

11.—SCOTTISH JUNIORS.—Joint Meeting at Glasgow. Address by G. Dixon (Junior Vice-President of the I.G.E.).

11.—YORKSHIRE JUNIORS.—Visit to Hopkinsons, Ltd., Huddersfield.

13.—I.G.E.—General Purposes Committee, 11 a.m.; Finance Committee, 1.45 p.m.; Membership Committee, 2.15 p.m.; General Purposes Committee, 3 p.m.

14.—I.G.E.—Council, 10 a.m.; Gas Education Executive Committee, 2.30 p.m.

14.—LONDON AND SOUTHERN JUNIORS.—Meeting and Paper by A. T. Green on "Features Concerning the Use of Refractory Materials in Gas-Works."

14.—N.G.C.—Meeting of the Central Executive Board, Gas Industry House, 2.30 p.m.

16.—S.B.G.I.—Council Meeting, 2.30 p.m.

16.—I.G.E.—Refractory Materials Joint Committee 2.30 p.m.

20.—LONDON AND COUNTIES COKE ASSOCIATION.—Finance Committee, 10.45 a.m.; Executive Committee, 11.15 a.m.; Central Committee, 2.30 p.m., Gas Industry House.

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Jan.

1.—LONDON AND SOUTHERN JUNIORS.—Visit to the Headquarters of the London Fire Brigade.

7.—I.G.E.—Joint Committee on Complete Gasification under Pressure, 3 p.m., at 16, Old Queen Street, S.W. 1.

8.—SCOTTISH EASTERN JUNIORS.—Visit to Milne's Meters, Ltd., Edinburgh.

13.—MIDLAND JUNIORS.—Meeting and Paper by A. T. Green.

News in Brief

CURRENT EVENTS IN THE GAS INDUSTRY

The Offer of the New Romney Gas Company to improve the lighting and heating of the Council Chamber has been accepted by the Town Council.

The Tender of Messrs. West's Gas Improvement Company for the reconstruction of two beds of vertical retorts at Greenbank Gas-Works, has been approved by the Blackburn Town Council.

For the Position of Chief Engineer the Directors of the Newcastle-upon-Tyne and Gateshead Gas Company are inviting applications. Further particulars of the position will be found in the advertisement columns of this issue.

Applications for the Position of Gas Engineer and Manager are invited by the Bolton Corporation. Particulars of the position, which carries a commencing salary of £900 per annum, will be found in our advertisement columns.

Additional Lighting Installed at Folkestone for the Conference of the Association of Public Lighting Engineers is to be, for the greater part, retained. Gas standards erected are to be purchased over a period of five years at £152 per annum.

Application to the Ministry of Health for sanction to borrow £10,000 for the Gas Undertaking, in respect of prepayment installations, £4,000; hired apparatus, £4,000; and mains, £2,000, is to be made by the Ashford (Kent) Urban District Council.

Application to the Board of Trade for a Special Order under the Gas Undertakings Acts, 1920 to 1934, is intended to be made by the Looe Gas and Coke Consumers' Company, Ltd., with the object *inter alia* of authorizing the Company to supply within certain specified areas.

Although Unable to Swim, Mr. S. T. Yardley, an employee of the Leamington Priors Gas Company, on Nov. 24 pluckily jumped into the canal near the gas-works and rescued a child who had fallen into the water. After the rescue he changed his clothes and carried on as if nothing had happened.

An Interesting Visit was paid by members of the London and Southern District Junior Gas Association on Wednesday, Dec. 1, to the Engineering Works at Bedford of Messrs. W. H. Allen, Sons, & Co., Ltd. The Association were the guests of the firm at both luncheon and tea, and a cordial expression of thanks was voiced on behalf of the members by the President, Mr. R. N. LeFevre, of the Gas Light and Coke Company.

In Competition with Electricity, the Dewsbury Gas Department have been successful in obtaining contracts for the lighting of Leeds Road, Halifax Road, Huddersfield Road, Wakefield Road, Bradford Road, Savile Road, and Foundry Street with modern overhead lighting to specification E. The Street Lighting Committee have purchased the poles and gas lamps. The Gas Department now control over 95% of the street lighting in the Borough of Dewsbury.

Members of The Institution of Gas Engineers will be welcome at a meeting of the Illuminating Engineering Society on Tuesday, Dec. 14, at 7 p.m., at the Institution of Mechanical Engineers, Storey's Gate, S.W. 1, when a Paper entitled "Incandescent Gas Lighting" will be delivered by Mr. Dean Chandler, of the South Metropolitan Gas Company. The Paper will be followed by a discussion. Tickets can be obtained from the Secretary, The Institution of Gas Engineers.

Obituary

As we go to press we learn with great regret of the death of Mr. SAMUEL CUTLER, who passed away on the morning of Dec. 7 at his home, 3, Hans Crescent, S.W. 1, at the age of sixty-nine, after a very short illness.

The Second of a Series of Lectures to be given to Edinburgh Gas Department employees was delivered by Mr. A. F. Pollock, M.A., C.A., B.Com., in the N.U.P.E. Halls, Broughton Street, Edinburgh, last week. The subject, "Birth of Enquiry," was a commercial outline of the various ramifications of office work and the individual importance of each section. The costing system was also explained. During his talk, Mr. Pollock mentioned that wages took up more than half of the cost of administration in the Gas Department,

Demonstrations of Christmas Fare Cooking arranged by the Leamington Priors Gas Company are now being held. These demonstrations are being given by Miss M. Harris, N.S.T.C., M.C.A., of Messrs. Sidney Flavel & Co., Ltd. At each session there are also washing demonstrations by Miss D. Hodgson, of the Ascot Gas Water Heaters, Ltd. The prizes for a cake-icing competition include an "Ascot" water heater, a "Flavel" pressed steel fire, and a G.L.C. iron and flex. Mr. R. S. Ramsden, Director, General Manager, and Engineer, informs us that on the opening day many ladies were turned away as the demonstration hall was packed.

The New Showrooms of the Stanley Gas Company were officially opened last week by Mr. John E. Cowen, Chairman of Newcastle-upon-Tyne and Gateshead Gas Company. Mr. Cowen said that gas was first introduced to Stanley 70 years ago, when Messrs. Burn, then owners of West Stanley Colliery, installed it to serve their colliery. Since then rapid strides had been made in the Industry, and in the last few years the Company had installed over 4,000 gas appliances, including cookers, washing coppers and machines, and gas fires. Gas used was assisting employment in the mining industry of the district, as all the coal used in the process of gas manufacture was purchased locally.

A Series of very successful cookery demonstrations was held recently in the Hereford Gas Department's new demonstration room, Widemarsh Street, Hereford. The series of 18 lectures was attended by over 700. In addition, some 80 students of the Hereford High School attended a special session. The demonstrations, conducted by Miss Deakin, were arranged by Stoves, Ltd., in conjunction with the Gas Department. The prizes awarded to the successful entrants in the cake competitions were presented by Mrs. Bernard Powell, who spoke in very appreciative terms of the way in which Miss Deakin had conducted the demonstrations. On the platform the Chairman of the Gas Committee (Councillor F. Cuddon) was supported by the Vice-Chairman (Alderman Bernard Powell), Mrs. Bernard Powell, and Mr. A. Roberts (General Manager). Mr. Roberts expressed the thanks of all present to Mrs. Bernard Powell for presenting the prizes.

Amalgamation and Grouping

Coatbridge and Airdrie

In connection with the proposal of the Coatbridge Gas Company to purchase the Airdrie Gas Undertaking, the Airdrie Gas Committee have again asked the Company to indicate the purchase price they had in view in making their offer.

St. Helens and Rainford

Negotiations between the St. Helens Gas and Lighting Committee have resulted in an agreement with the Rainford Gas Company, Ltd., for the transfer of the undertaking, assets, and property of the Company to the Corporation, subject to the Town Clerk approving the terms of the agreement.

United Kingdom and Littleborough.

Shareholders of the Littleborough Gas Company are advised by the Directors to accept the offer of the United Kingdom Gas Corporation, Ltd., to purchase their shares on the following basis: For each ordinary £10 share of the Company, 21 fully paid ordinary £1 shares of the Corporation, ranking for dividend as from Jan. 1, 1938, with 9s. in cash.

Launch of Another Thames Gas-Works Collier

The S.S. "Wimbledon"

On Dec. 1 the 2,500 tons dw. steamer "Wimbledon," built by the Burntisland Shipbuilding Company, Ltd., for the Wandsworth and District Gas Company, was launched from the Burntisland Shipyard. Mrs. Cyril M. Croft, recently elected Councillor for the Springfields division of the Wandsworth Borough Council and wife of the Chief Engineer and General Manager of the Wandsworth Gas Company, performed the launching ceremony. This is the eleventh Burntisland-built ship to be launched this year to date. The s.s. "Wimbledon" will create a record for size and carrying capacity for vessels navigating the upper reaches of the River Thames, in the course of which no fewer than seventeen low span bridges have to be negotiated. The steam propelling machinery is of the most modern triple expansion type and is being supplied by Messrs. Aitchison Blair, Ltd., Glasgow. For the purposes of bridge navigation, the upper structure of this vessel is so designed that only the funnel and stokehold ventilators require to be hinged, while the foremast telescopes into a tube and the mainmast hinges down when passing under the various bridges. For securing the quickest dispatch as regards both loading and discharging, the cargo hatchways are of self-trimming design with Neilson patent rolling hatch beams, and the cargo holds are of hopper type construction so that the cargo flows by gravity to the discharging grabs. An interesting feature in connection with the culinary arrangements on the "Wimbledon" is the type of cooking stove which is fitted to the midship accommodation. Here gas is employed and a special type stove using Calor gas supplied from portable containers is the means by which the cooking services are carried on.

In a speech following the launch, Mr. Cyril M. Croft referred to the fact that 50 years ago some 28,000 tons of coal were needed yearly to fulfil his Company's requirements. To-day, he pointed out, the coal requirements amounted to over 400,000 tons per annum. In 1906 the late Mr. H. E. Jones, the Chairman of the Company, conceived the idea that it would be possible to bring coal direct from North-East Coast ports to Wandsworth under the then existing 17 Thames bridges, and in September of that year the "Ratcliff" made her first trip to Wandsworth carrying about 1,050 tons of coal, which was unloaded by the Company's floating pontoon moored in midstream and provided with two steam cranes. The advent of steam colliers proceeding direct to Wandsworth was the forerunner of great and continued advancement in up-river navigation of the Thames by ocean-going colliers. The Wandsworth Gas Company, Mr. Croft suggested, were the pioneers in this important navigational innovation and had led continuously in the development of this coastwise and up-river coal traffic. Since 1906 to the present day had been a period of continuous development in shipbuilding by the Wandsworth Company. The first ship specially built for the navigation of the Thames bridges as far as Wandsworth was the "Wandle No. 1" built in 1908, having a carrying capacity of approximately 1,250 tons. This was followed in five years by the "Mitcham," which carried 1,450 tons, and then early in 1923 the "Wandle No. 2," built by the Burntisland Shipbuilding Company, carrying 1,450 tons. In 1924 the "Woodcote," having a carrying capacity of 1,800 tons, was built by the same Company. Then followed in quick succession the "Ewell No. 2," 2,000 tons, the "Tolworth," 2,000 tons, and the "Wandle No. 3," 2,100 tons.

Gas Lighting Improvements in West London

The new Parkinson "Maxill" gas lamp is to be used for the first time in London in the Gas Light and Coke Company's scheme for modernizing Paddington's main street lighting. The complete installation will double the existing light output.

Seventy-three of these lamps will be erected in Praed Street, Porchester Road, Queen's Road, Westbourne Grove, Clifton Road, and Carlton Vale, and they will be mounted on steel columns 120 ft. apart and 25 ft. above ground level. The effect will be to form a bright background against which pedestrians, motor cars, and other traffic will stand out clearly as silhouettes. The existing lamps will be transferred to Elgin Avenue and Sutherland Avenue to replace smaller lamps.

The Science of Petroleum

The great treatise on the "Science of Petroleum" which has been prepared under the editorship of Dr. A. E. Dunstan, Professor A. W. Nash, Sir Henry Tizard, K.C.B., F.R.S., and Dr. Benjamin T. Brooks, of New York, will be published by the Oxford University Press, London, in December or January. For the convenience of readers it has been decided to issue the work, which will contain more than three million words and thousands of illustrations, in four volumes, instead of three, as previously announced. The price will remain the same, at fifteen guineas. Orders for a large part of the edition have already been received.

Corrections

In his remarks with reference to Mr. G. M. Gill's Paper before the Midland Association of Gas Engineers and Managers, on p. 730 of the "JOURNAL" for Dec. 1, we reported the President (Mr. H. Davies, of Chesterfield) as saying that all gasholders of a capacity of more than 500,000 cu.ft. were affected by the provisions of the new Factory Act. Mr. Davies writes to point out that this should read 5,000 cu.ft.

In the course of his remarks in the discussion on Mr. R. Aynsley's Paper read before the North of England Auxiliary Association, Mr. J. W. Pallister (the Chairman) is reported (on p. 737 of last week's "JOURNAL") as saying that in Middlesbrough the collections averaged 35s., requiring two collections per quarter. Mr. Pallister writes to correct this figure to 75s. per meter.

A New Australian Showroom

These attractive new showroom premises were recently opened by the Brighton Gas Company at Bentleigh, Victoria.

Gas Films at Scottish Domestic Science College

Enthusiastic Reception by Staff and Students

A programme of gas publicity films was recently given through the courtesy of Miss Melvin, Principal, at the Glasgow and West of Scotland College of Domestic Science on Wednesday, Dec. 1, from 2 p.m. to 4 p.m. The programme included the following films: "How Gas is Made," "Pots and Plans," "How to Cook," "Nutrition," "Dinner Hour," "Kensal House," and "White Magic."

The audience, numbering approximately 700 persons, consisted of members of the staff and students of the College. All the films were the subject of favourable comment, and were enthusiastically received. At the conclusion of the programme a vote of thanks was proposed by one of the students, and on behalf of the Gas Industry, Mr. W. R. Drummond, Secretary of the National Gas Organization in Scotland, suitably replied.

Scottish Empire Exhibition

A National Gas Exhibit

At a meeting of the Executive Committee of the British Commercial Gas Association held in London on Nov. 17, the nature and scope of the National Gas Exhibit to be staged at the forthcoming Empire Exhibition was discussed, and it was unanimously resolved that, in addition to the space already taken up within the Palace of Engineering, a site be obtained for the erection of a separate Gas Pavilion.

Such a site has now been secured, offering one of the

finest positions in the Exhibition Grounds. It has been decided that the National Gas Exhibit, which will be under the auspices of the British Gas Federation, will take the following form: (*a*) The space within the Palace of Engineering to be an Industrial Exhibit, and (*b*) the separate Pavilion to house Domestic Exhibits.

The Executive Committee remitted the matter to the Scottish Management Committee of the B.C.G.A., who, for the purposes of organizing and planning the exhibit, have elected a small Working Committee, composed of the following: Mr. David Fulton (Helensburgh), Mr. Archd. Kellock (Airdrie), and Mr. R. D. Keillor (Greenock). Mr. Fulton has been appointed Chairman.

Edinburgh, Glasgow, and Newcastle have indicated their willingness to co-operate and assist the Committee in every way possible.

Glasgow and Coke Oven Gas

Date Fixed for Conference

Glasgow Corporation and representatives of William Dixon, Ltd., will meet on Dec. 16 to discuss the offer made by the Company to supply 6 million cu.ft. of coke oven gas a day from the coke ovens at Govan iron works, within the City limits.

It will be recalled that in February this year a ten-year-old contract with James Nimmo & Co., Ltd., to supply about 2 million cu.ft. of gas daily from coke ovens some five miles outside the City was cancelled. At the same time, an offer by William Baird & Co., Ltd., to furnish gas from a proposed cokery at Gartsherrie, also outside the City, was laid aside until the Dixon issue should be settled.

The former Nimmo contract was at 11d. per 1,000 cu.ft., and the original Baird offer was at 8·4d. per 1,000 cu.ft. The most recent Dixon quotation is at 5·5d. per 1,000 cu.ft. of unpurified gas, which is the same as the price paid by the Sheffield gas grid.

Though it is claimed that the full disposal of the gas would give a manufacturing credit to Scottish pig-iron makers of the order of 10s. per ton of metal, Glasgow Corporation has refused to provide a market, and negotiations over a period of years have been abortive. The municipal attitude is that public gas-making plant should not be rendered idle to benefit private undertakings. A special committee appointed by the Board of Trade recommended that the City should change its decision and a similar view was taken in the recently-published report of the Commissioner for the Special Areas in Scotland.

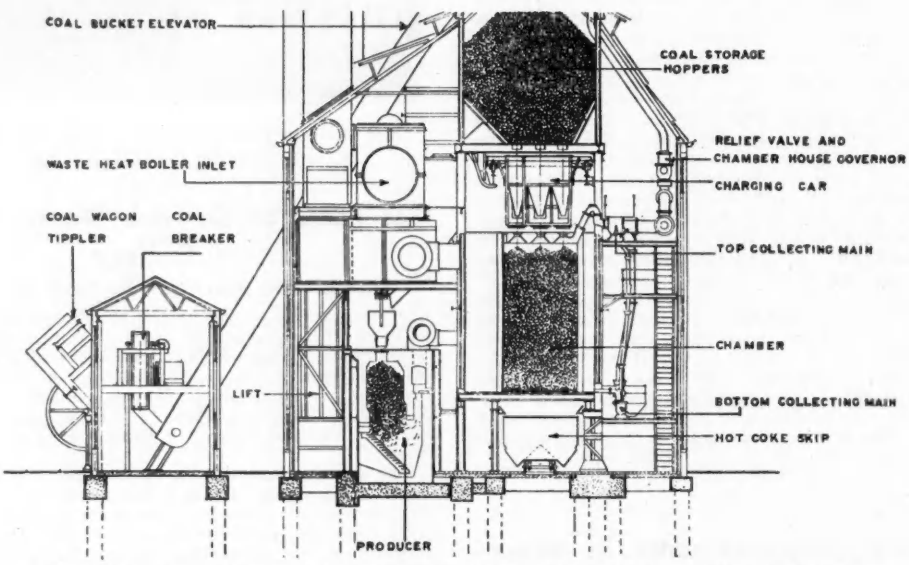
The Corporation is apparently more favourable to the Dixon concern, which works inside the municipal boundaries. Proposals have been made locally that the steel industry should provide a market, as the steel furnaces are not far distant from the coke ovens, extant and projected. These, however, have not found favour in industrial circles.

Inaugural Speeches at Weston-super-Mare

In last week's issue we gave a full description of the new carbonizing plant at Weston-super-Mare, erected by the Woodall-Duckham Companies. The plant was officially inaugurated on Dec. 1 by Sir Harold Hartley, C.B.E., M.C., F.R.S., in the presence of a large company, who subsequently inspected the installation with great interest.

An outstanding feature of the plant is elimination of the recuperators. The producers are built separately from the settings as an independent battery, the heat in the waste gases allowing a greater recovery of steam. The diagram we are able to reproduce will make this unusual arrangement clear.

Following the inspection an adjournment was made to the Grand Atlantic Hotel for luncheon, under the Chairmanship of Alderman Henry Butt, who, in addition to being Chairman of the Weston-super-Mare Gas Company, was present in the capacity of Charter Mayor of the Borough.



Cross Section through the new W.D. Intermittent Chamber Oven installation at Weston-super-Mare.

The toast of "The Weston-super-Mare Gas Company" was proposed by Sir Harold Hartley, who pointed out that the new carbonizing and coke handling plant had been necessitated largely to meet the increased demand for gas which had arisen as a consequence of the Company's rural area development. He congratulated the Chairman and Directors of the Company upon a most favourable improvement in their manufacturing resources, and the Engineer, Mr. James Taylor, for his share in the new development. He also congratulated the Contractors, Messrs. Woodall-Duckham, on the design and construction of the plant and also upon its general appearance, which, he said, mattered a good deal in these days, when so much importance was attached to the aesthetic side of industrial buildings.

Captain A. G. Picton Davies, Deputy Chairman of the Gas Company, replied to the toast and said that it was the endeavour of the Company always to serve the interests of the consumers in the spirit of the motto of the Borough, which was "Ever Forward." Captain Davies paid tribute to the manner in which the Directors had been able to place confidence in their Engineer in connection with the new plant, and he referred further to the real team spirit which existed throughout the Undertaking—in the technical staff under Mr. J. T. Spencer, and the Secretarial Department under the able leadership of Mr. J. F. Marlow.

"The Borough of Weston-super-Mare" was proposed by the President of The Institution of Gas Engineers, Mr. H. C. Smith, to which Alderman Henry Butt replied, paying a tribute to the Gas Company, which now had works second to none in the country.

Mr. James Taylor, giving the toast of "The Contractors," paid a high tribute to the manner in which they had carried out their work. Mr. F. B. Richards responded, and finally Colonel C. Gordon Fleming proposed the toast of "Our Visitors," on whose behalf Mr. R. W. Hunter, Chief Engineer to the Gas Light and Coke Company, responded.

Town Gas as an Industrial Fuel

by
C. M. WALTER,
D.Sc., M.Inst.Gas E.,
A.M.I.E.E., M.Inst.Met.,
&c.

From a Paper read at the Joint Meeting of the Manchester District Association of Gas Engineers and Managers and the Institute of Fuel, Manchester, on Nov. 24.

The developments in the use of both town gas and coke oven gas in industry, while perhaps phenomenal, can be accounted for in many ways, particularly when we review the position during the period of trade depression which preceded the present more prosperous period of trade activity. Even at that time the many advantages associated with the use of town gas as industrial fuel were fully appreciated by many industrialists who had, for many years, used this form of fuel in many manufacturing operations. During recent years industrialists have obtained a great deal of useful information in regard to the economic advantages which this form of fuel possesses as compared with other forms of fuel in a very wide range of heat applications. It was, therefore, appreciated that with the return of trade to more normal conditions, there would be a considerable increase in the demand for town gas, not only for use in those industries in which it had already established itself, but in many other industries where, as the result of research and experimental work which had by that time been undertaken both by furnace manufacturers and gas undertakings, it was felt that this form of fuel would have its field of applications considerably extended.

During the last few years of trade prosperity we have, therefore, as was expected, seen some development of the use of this form of fuel in practically every industry in which heat application is employed, ranging from the heavy industries, including the manufacturing and processing of iron and steel, to the lighter industries, in which town gas is now used in many hundreds of heat operations. Notable examples of the light industries in which town gas has firmly established itself include the cycle, motor cycle, and motor car industries, the motor accessory manufacturers, the ferrous and non-ferrous metal industries (including the production of billet, strip and sheet), rod and tube manufacturers, the aluminium and light alloy industries, the ceramic industries, gas and electric appliance manufacturers, the wholesale production of foodstuffs, the textile industry, the plastic industries, together with many other industries ancillary to these.

We are aware of the striking example of the use of surplus coke oven gas in the Sheffield Gas Company's area of supply, as a result of the inauguration of the South Yorkshire Gas Grid, which is owned and operated by this Company. Quoting figures which were recently published by Mr. Ralph Halkett, General Manager and Secretary to the Sheffield Gas Company, we find that Sheffield manufacturers used no less than 5,565,774,000 cu.ft. of gas in 1936 for industrial heating purposes, representing over 3,000 million cu.ft. in excess of the quantity used in 1931, or an increase of 135% in five years. Side by side with these developments in the application of coke oven gas in Sheffield, we find similar developments in other districts where surplus coke oven gas is available for the heavy industries.

It is well known that the Birmingham Gas Department was among some of the earliest gas undertakings who anticipated to a certain extent the huge developments which have taken place in the use of gas in industry, and as early as 1909 the Birmingham Gas Committee thought fit to give special consideration to this matter, with the result that two years later special departments were established to deal with the development of the use of town gas in the many industries carried out in its area of supply. This was again followed a few years later by the establishment of a complete suite of Research Laboratories and an extended Heat Treatment Section, whereby manufacturers could obtain expert advice in the application of town gas to their particular trades and processes, and at the same time carry out if necessary full scale tests in order to satisfy themselves as to the economic value of this form of fuel for any particular heat operation. Some idea of the extent to which town gas is now used for industrial purposes in the area of supply of the City of Birmingham Gas Department may be obtained from an analysis of the returns of the sales of gas for the year ended March, 1937, which show that, of the total of gas sold for all purposes, which amounted to 15,791 million cu.ft., no less than 5,234 million cu.ft. was consumed in factories. So great is the demand at the present time that the Gas Committee have decided to extend further this section of its activities by the establishment of new buildings, including a Heat Treatment Section, Industrial Demonstration Rooms, and Laboratories. Reference should also be made to the developments which have taken place in the London area, more particularly in connection with the light, and in some instances luxury, industries, and also industries associated with the wholesale production of foodstuffs.

The demands of industry are for a fuel which shall be uniform in composition, capable of being controlled automatically in regard to both temperature conditions and conditions of atmosphere produced in the fuel burning appliances. Moreover, a wide range of thermal concentration is sometimes called for, as we have to deal with operations such as forging and metal melting in which extreme thermal concentration is necessary in order to obtain the requisite working temperature; on the other hand, other operations call for a much lower temperature and lower degree of thermal concentration.

As an example of the part which town gas has played in improving the methods of heat application in those industries in which mass production lines form a most important part of the organization, I should like to refer to extended use of the continuous type of furnace, which has now been developed to such a high degree as to enable it to take its place in the production line in the same manner as a machine tool.

In the past there was a tendency for industrialists to assess the value of a particular fuel from consideration only of its thermal cost. With an increased knowledge of fuel application, we have found more recently that thermal cost, coupled with the efficiency of utilization, forms the basis of assessing the economic value of a fuel in many operations. The true economic value of a fuel can only be obtained by assessing the " all-in " cost of production.

The Heavy Industries.

As examples of the applications of coke oven gas in the heavy industries of the country, I should like to refer to one or two installations of furnaces, particulars in connection with which have been kindly supplied to me by Mr. Halkett, General Manager and Secretary of the Sheffield Gas Company. The first example is a furnace built by Messrs. Brayshaw, Ltd., of Manchester, and incorporating the atmosphere control process developed by the Sheffield Gas Company and used for the heating of steel slabs for pressing and ultimate rolling into sheets. This furnace is used in the manufacture of " cladded " steel or steel veneered with stainless, high speed, or any other form of steel. It is an essential feature that no scale be formed on the slabs during the heating process. The furnace is completely automatically controlled in regard to both temperature and atmosphere.

[The Author then illustrated by lantern slides a battery of gas fired furnaces in a Sheffield steel works, used for the heating of slabs of steel and alloys, such as stainless steel, for subsequent rolling into sheet, and a town gas fired twin muffle furnace, installed at a Sheffield works for the heat treatment of stainless steel strip.]

I should also like to refer to a continuous counterflow furnace made by Messrs. British Furnaces, Ltd., and used for the annealing of small cast iron parts. The material is heated from room temperature to 1,200° F. in 2½ hr. and then cooled to 500° F. The heat exchange zones are 3 ft. 9 in. wide by 12 in. high by 4 ft. long; the central high temperature zone has a hearth 4 ft. wide by 4 ft. 9 in. long, and is without a dividing wall. On actual test the rate of production was 810 lb. gross, or 640 lb. net per hour. Over a day's run at this output 1·95 lb. gross were heated per cu.ft. of gas, equivalent to 1·54 lb. net per cu.ft. The thermal efficiency gross was 57·4% and 45·5% net, and even over a week's tests was 48·3% gross and 38·1% net.

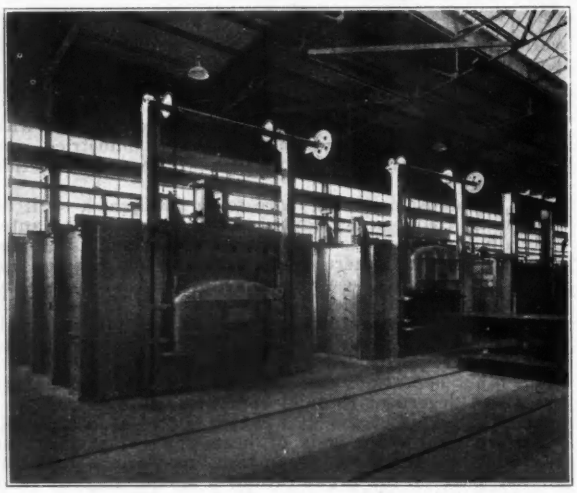
Cycle, Motor Cycle, and Motor Car Industries.

Probably in no other industry is gas used to the extent that it is employed in the combination of trades and processes which are included in the cycle, motor cycle, and

motor car industries. There are many factories in which gas is used exclusively for the many heating processes.

Liquid Brazing.

Everyone is familiar with the blowpipe method of brazing. In the Gas Industry it has long been recognized that while this process represented a considerable gas load, it was one of the most inefficient of industrial heat



Gibbons Low-Temperature Furnace at I.C.I. (Metals), Ltd., Birmingham

applications, and many attempts have been made to increase its efficiency by methods of preheating joints for brazing, &c., many of them quite ingenious. This method still has to be used for special work, particularly with motor cycle frames, but in factories where continuous production of cycle frames obtains, and suitable furnaces can be used for dealing continuously with one type of joint, then the adoption of the liquid method of brazing leads to a considerable increase in the efficiency of application, and so reduces the cost per joint.

The furnaces are fitted with a special type of crucible to accommodate the type of joint to be brazed, in which suitable solder is kept in a molten condition at about 900° C. Gas used with air at a pressure of from 1-2 lb. per sq.in. has been found one of the most satisfactory forms of heating these furnaces, maintaining high rate of production with minimum cost of pot life, repairs, and maintenance charges.

Enamelling (Japanning).

The majority of ovens now being installed for this process are of the continuous conveyor type employing town gas fired air heaters of the direct fired type. These, with automatic temperature control apparatus, are providing in a large number of factories an economical and highly satisfactory type of heating, which can satisfactorily compete with any other form of fuel.

A large number of similar types of continuous ovens with gas fired heaters are in use for tin printing and similar operations, and drying operations of all kinds.

Heat Treatment.

In the carrying out of the many heat treatment operations connected with these industries, town gas fired furnaces have been accepted practice for many years. Oven furnaces are mainly used, and all sizes having hearth areas of a few square inches to furnaces as large as 8 ft. × 4 ft. are called for, together with many continuous conveyor types. The processes covered include tool hardening of carbon and high speed steels, annealing, normalizing, tempering, carburizing, and re-heating for hardening after carburizing.

Recuperation of heat from the waste gases or recuperation through the load is now an accepted feature of standard designs by all makers, the amount of recuperation being decided by the performance expected from the furnace, and particularly the number of hours it is to be in continuous working operation. Similar considerations decide the amount of insulation to be applied in the structure. I would like to commend the great value of the special insulating and refractory materials now available for incorporation in furnace construction.

Brief reference must be made to the cyanide method of case hardening which has made rapid headway and replaced to a large extent the older method of box pack hardening, in cases where only a shallow depth is required and for special work. Speed is the essential feature of the process, with the elimination of boxes, the necessary carburizing material, and the labour necessary for packing. Against this elimination has to be set the pot life and replacement of the cyanide material. A large number of installations are in successful use, the furnace being constructed by several makers, including the Cassel Cyanide Company branch of Imperial Chemical Industries, who have made a special study of furnace design connected with cyanide case hardening and heat treatment, and produced standard designs in various sizes, which are extremely successful in use. Gas and air under pressure are used in most instances as the heating medium.

A very successful low-pressure gas fired cyanide or salt bath furnace has been designed by the Gas Light and Coke Company, and is made under licence by recognized furnace manufacturers.

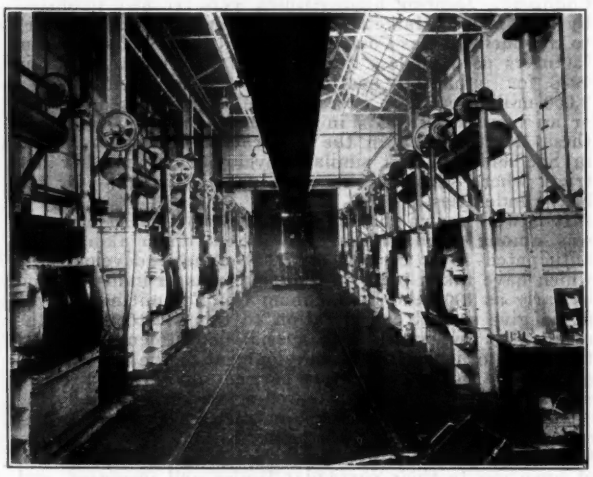
Tempering.

Salt bath furnaces, mainly of the natural-draught gas fired type, are extensively used for tempering operations, but I must make special reference to the recent great advances in the use of heated air as a tempering medium. Messrs. Brayshaw are supplying a number of low-pressure gas fired furnaces with fan to provide air circulation, and Messrs. Serck Radiators are supplying large numbers of "Serckulators" for air tempering operations. In the "Serckulator," complete control of the air condition in the oven is obtained with even temperature conditions, while heating can be carried out with pure air, partially mixed air and products of combustion, or with air, products of combustion, and recirculated air from the working oven, as desired, or the exigencies of the particular operation demand.

Messrs. Vauxhall Motors, Ltd.

I am permitted to include particulars of a recent installation of five carburizing furnaces at the works of Messrs. Vauxhall Motors, Ltd., Luton, by Messrs. Lucas Furnaces, Ltd., of Birmingham. I understand that Messrs. Lucas have just completed a further installation of six furnaces at this particular works following the excellent results obtained from the first installation.

The size of furnace selected has hearth dimensions 6 ft. deep × 3 ft. wide, and the design embodies a sound construction of high quality refractories with a good insulating wall, making a total wall thickness of 18 in. operating on Lucas standard gas fired natural-draught principles, with



Installation of Carburizing Furnaces by Messrs. Lucas Furnaces, Ltd., at the Vauxhall Motor Works, Luton.

metal recuperators, the floor of the hearth being arranged to take a charging machine.

The gas pressure is governed and the temperatures are automatically controlled with damper control included.

Control operates 45 minutes after full load is charged and load is soaked through in two hours.

Gas consumption during control is a maximum of 850 cu.ft./hour and a minimum of 200 cu.ft./hour.

The following test figures were obtained during test runs on the first five furnaces referred to:

Furnace.	Hour Heat.	Load, Lb. Gross.	Temperature. °C.	Gas Consumption. Cu.Ft. per Lb.
No. 1 . . .	6	1,500	980	1·90
No. 2 . . .	5½	1,464	960	1·93
No. 3 . . .	5¾	1,458	960	2·01
No 4 . . .	6	1,0.6	960	1·91
No 5 . . .	5¾	1,416	960	1·94

Penetration – 1/32 in.

Gas consumptions of each of these five furnaces were taken at 15 minute intervals.

These figures compare very favourably with recent tests the Author has had made on modern recuperative type gas fired furnaces, especially if it is noted that in the Vauxhall furnaces operating temperatures are of the order of 960°-980° C. instead of the more usual temperature of 920° C. Of course, it will be realized that such low gas consumptions can only be obtained with furnaces of this design operating continuously for 24-hour days.

Continuous Normalizing and Heat Treatment.

For my examples of continuous furnaces, I would refer in the first place to an installation of a walking beam type furnace made by Messrs. Gibbons Brothers, Ltd., Dudley, and installed at the works of Messrs. Wolseley Motors, Ltd., Birmingham. The furnace operates on low-pressure gas with low-pressure air under lambent or white flame combustion conditions, dealing with approximately one ton of forgings per hour for normalizing at a temperature of 920° C. under automatic control.

The work is placed in nickel chrome pans and the furnace has been in practically continuous operation for over three years with hardly any maintenance charges or repairs to the furnace having been found necessary.

The second example is the semi-continuous through type gas fired furnace made by Messrs. Lucas Furnaces and installed at the works of Messrs. Hardy Spicer, Ltd., Birmingham, the Birmingham Small Arms Company, Ltd., and other works.

These furnaces are excellent examples of modern furnace design, materials of construction being selected for heat transmission, insulating, and wearing capacities in their respective places, coupled with the fact that a soundly designed conveyor mechanism is incorporated.

It has recently been our privilege in Birmingham to carry out an extensive test on one of these furnaces at Messrs. Hardy Spicer, Ltd., and a summary of the results obtained is given:

Furnace makers —Messrs. Lucas Furnaces, Ltd.

Size of furnace.– 15 ft × 2 ft. 6 in. × 1 ft. 6 in. dimensions of working chamber, including 5 ft. 6 in. of load pre-heating chamber.

Design of furnace.—The furnace was designed for load and air recuperation, and fitted with a gear type pusher gas sealing head; also arranged for direct quenching. Number of burners, 18.

Results—

Number of pans	54	
Total gross weight	14,267	lb.
Total gas used 9.12 a.m.–7.19 p.m.	11,370	cu.ft.
Gas used per lb. work treated . .	0·797	,,
,, ,, ,, ton ,, ,, . . .	1,786	,,
Rate of throughput	12·6	cwt./hr. gross
Thermal efficiency	62·9	%

Messrs. Hardy Spicer use a large number of gas fired furnaces for other general heat treatment operations in the production of their well-known universal joints and other special features of motor car chassis design.

A battery of three walking beam town gas fired furnaces by the Incandescent Heat Company is installed at the works of Messrs. Samuel Fox & Co., Ltd., Stockbridge. Each furnace is 25 ft. long × 6 ft. wide, and has a capacity of 2 tons per hour.

The first furnace is designed to preheat laminated spring plates from cold to 900° C. The plates are then discharged automatically and loaded into the second furnace, in which they are heated and soaked thoroughly at a critical temperature of 925° C. From the discharge end of the second furnace the plates gravitate into a special automatic cambering machine where setting and quenching takes place simultaneously. The springs are automatically discharged from the quenching bath of the setting machine and loaded by hand into fabricated steel crates which are then loaded on to the charging table of the third furnace. The plates are tempered at approximately 530° C. and discharged near the assembly bays.

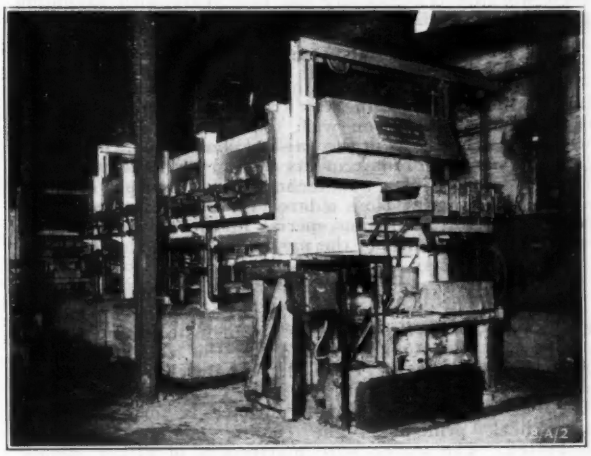
Roller Hearth Furnace.

A town gas fired roller hearth furnace made by the Incandescent Heat Company, 13 ft. long × 1 ft. 6 in. wide is installed at the works of Morris Commercial Cars, Ltd., and is used for heat treating gear box parts.

The production of laminated springs for motor vehicles affords an interesting example of the advantage of using a fuel which can be burnt with varying degrees of thermal concentration as required to suit the different operations in the manufacture of the springs, and the combustion of which can be scientifically controlled, for spring steel, which is a silica-manganese, is very susceptible to overheating.

Forging.

In the Midlands a large number of firms produce steel forgings and drop stampings for the automobile and other industries, and, of course, a large number of nuts and bolts are also produced. Town gas has long been recognized as an ideal fuel for the heating of steel bar for the production of nuts and bolts, and several very successful installations exist. Competition in these processes in the Midlands lies with both solid and liquid fuel.



Walking Beam type of Town Gas-Fired Furnace by the Incandescent Heat Company installed at the works of Messrs. Samuel Fox & Co., Ltd., Stocksbridge. This furnace is 25 ft. long by 6 ft. wide, with a capacity of 2 tons per hour.

In regard to the use of gas in what may be termed the small type of forging furnace for the production of drop stampings, a considerable amount of experimental work has been carried out over the last five years in districts supplying gas at figures which, coupled with the use of efficient forms of furnaces, the economic relationship between the costs of work with gas and liquid fuel (as its chief competitor) have been even. In the case of stampings, special alloys, and also in the case of the heating of steel for the machine production of forgings, gas furnaces have shown to advantage.

A number of successful and economical installations are running in Birmingham and other districts for these classes of work, and in all of them gas has revealed itself as a fuel which is controllable, gives speedy generation of the required high temperatures, producing at maximum speeds the cleanest type of forging or stamping, and there is no doubt that wherever gas can be supplied at economic rates there is every justification for its use for these operations.

The following are particulars of a test carried out on a standard type gas fired forging furnace, using gas at ordinary main pressure and air at 2 lb. per sq.in. with a metal air recuperator. The dimensions of the working chamber in this case were 24 in. wide × 15 in. deep × 10½ in. to the

crown of the arch, and it was used for the heating of small steel billets for drop stamping.

Test Results.

Total hours furnace lit	38 hrs. 50 mins.
Total gas consumption	45,460 cu.ft.
Average gas used/hour	1,170 ,,
Total stamping time	32½ hrs.
Number of stampings made	1,120
Weight of stampings made	6,160 lb.
Average number of stampings made/hour	34·5
Average weight of stampings made hour	189·5 ,,
Overall gas used/ton stampings made	16,530 cu.ft.
Overall gas used/gross stampings made	5,840 ,,
Average temperature of furnace chamber	1,380° C.
Average temperature of bars	1,300°–1,350° C.
Average CO_2 content of products of combustion as determined by Orsat gas analyzer	11·5 %

It may be said that town gas fired furnaces are more widely used than furnaces fired by any other form of fuel for the process of heating brass billets for the production of stampings used in the brass foundry trades.

Pen Hardening and Annealing.

An excellent example of the use of gas in the lighter trades is taken from an installation of furnaces for the annealing and hardening of pen nibs and spring steels at the Birmingham Works of Messrs. Baker & Finnemore, Ltd. This Company have made use of gas for many years for tempering and colouring operations, and also partly for annealing and hardening, but only recently have they equipped their works with two latest pattern gas fired oven furnaces which with one remaining solid fuel fired furnace carry their heat treatment load. The two gas fired furnaces were made by the Incandescent Heat Company, Ltd., and are of recuperative type. One of these furnaces has been working continuously for two years with minimum attention, no repairs having been found necessary.

Special Atmospheres.

For many years town gas has been employed as a sealing medium for certain heat treatment operations, more especially in connection with tool hardening, where the work to be treated is in the finished condition. During the last few years the requirements of industry have demanded the development of a new technique in this class of work, and at the present time a large quantity of town gas is being used for producing special furnace atmospheres to suit the requirements of the particular process.

Bright Annealing.

A continuous town gas fired bright annealing furnace of the mattress conveyor type has been installed by the Incandescent Heat Company, Ltd., at the works of Messrs. Siemens Brothers & Co., Ltd., Woolwich, for handling steel and brass pressings, capacity 1 ton in eight hours. The effective sealing of this furnace is formed on the camel-back principle. The cooling chamber is water jacketted. The woven wire mattress is of nickel chrome construction which obviates the necessity for boxes or trays. The working temperature range in the furnace is from 350° C. to 850° C. Brass pressings are annealed at 650° C.

The gas consumption for products bright annealed at a mean working temperature of, say, 700° is approximately 2 cu.ft. per lb.

Atmosphere Cracked Town Gas.

[Dr. Walter illustrated a battery of gas fired radiant tube lift-off or bell type furnaces for bright annealing 700,000 tons of steel per year in both sheet and coil form. This plant is of the Lee-Wilson type and is installed at the Gary Works of the Carnegie Illinois Steel Company near Chicago. Many of these units are now being constructed in Great Britain and in European countries. An outstanding feature of this system is that the charge is heated by radiant heat from nickel chrome tube radiators of parabolic formation.]

I am indebted to the Directors of Messrs. I.C.I. Metals, Ltd. (formerly Messrs. Kynochs, Ltd.), Witton, Birmingham, for permission to refer to their recent wide adoption of town gas fired furnaces in their tube and sheet mills in connection with their metallurgical processes. They are now using gas at their Witton Works to the extent of 280 million cu.ft. per annum. In the tube mill the heating of copper billets is carried out in gas fired furnaces made by Messrs. Gibbons Bros., Ltd., each furnace being 18 ft. 6 in. long × 10 ft. wide × 4 ft. high. In this furnace two tons of copper billets are heated per hour to a temperature of 900° C. and the average gas consumption works out at 1,500 cu.ft. per ton on 475 B.Th.U. gas, which represents an efficiency of approximately 54%. In the sheet mill there is a low temperature annealing muffle furnace, again made by Messrs. Gibbons Bros., the heating being carried out on the radiant tube principle for the heat treatment of aluminium alloys. The size of the furnace in this case is 14 ft. long × 6 ft. wide × 1 ft. 6 in. high, the operating temperature being 420° C.

Vitreous Enamelling.

The Incandescent Heat Company are installing many of their "Equi-Radiant" type of town gas fired furnace with charging gear for vitreous enamelling of cast-iron parts. The particular feature of this system is that firing is effected through transversely disposed refractory radiant tubes within an insulated chamber. It is possible to obtain three times the heating surface with this system as compared with an ordinary muffle chamber, the heating being effected on the immersion principle. Waste gases are partly recuperated and further utilized for drying operations prior to fusing.

Steam Raising.

[Dr. Walter then showed slides of gas fired steam boilers by the Parkinson Stove Company, Ltd., and by Messrs. Cochran & Co.]

Gas in the Textile Industry.

Gas is used in practically all branches of the textile industry for a very large number of heating processes necessary in the manufacture and finishing of textile goods.

The yarn gassing process is carried out in about 270 mills in Great Britain, the majority being located within a 30-mile radius of Manchester. A horizontal frame normally has 120 burners, each consuming 1 cu.ft. of gas per hour. Twelve horizontal frames per gassing room is a good average. The yarn speed with a horizontal frame is usually about 5,500 in. per burner per minute.

A vertical yarn gassing frame normally has 100 burners, each having an average gas consumption of 2·5 cu.ft. per hour. Yarn speeds with this form of plant are as high as 15,400 in. per burner per minute. Six vertical frames is a good average number per gassing room.

Cloth Singeing.

The singeing of cotton and artificial silk piece goods is the first process in textile finishing works, and is done to remove all loose fibres, hairs, and knots from the cloth prior to bleaching, dyeing, or printing. Various forms of singeing machines are used, having direct flame singeing burners, or gas-heated copper singeing plates, or a combination of both. The cloth singeing process is carried on in about 650 finishing works in Great Britain. Cloth speeds with singeing machines of this kind vary from 80 to 150 yd. per minute. Plate temperatures are from 800° to 860° C. The average gas consumption is 12 cu.ft. per hour for every inch length of a copper plate, thus the total consumption with a plate 60 in. long will be 720 cu.ft. per hour.

Calender Heating.

Practically all calenders are now gas heated. The three main classes of calenders are (1) glazing, to impart lustre; (2) swissing, to compress the cloth and give a compact appearance with only a moderate lustre; (3) embossing, to produce special lustre effects. Although calenders may comprise any number from two to ten bowls or rollers, only one bowl of each calender is usually heated. Gas consumptions are at the rate of 40 cu.ft. per hour for every 12 in. width of working face in heating from cold, and average 15 cu.ft. per hour under normal running conditions. Friction calenders with which heat is generated by bowl contact require no further gas at the termination of the heating from cold period.

[Dr. Walter concluded his Paper by referring to the organization within the Gas Industry for developing the industrial load.]

Wales and Monmouthshire Junior Gas Association

Visit to Cardiff Engineering Exhibition

On Nov. 23rd, members of the Wales and Monmouthshire Junior Gas Association paid an official visit to the South Wales Engineering Exhibition at the Grayfriars Hall, Cardiff. The exhibition was held under the auspices of the South Wales Institute of Engineers, whose President-Elect, Mr. E. Ivor David, welcomed the members. The President of the Juniors, Mr. H. V. Williams, Cardiff, replied to the address of welcome.

Measurement of Gas-Works Temperatures

by
E. HADEN,
of the Central Laboratory, Nechells, Birmingham.

From a Paper presented at a meeting of the Midland Junior Gas Association at Birmingham on Nov. 18—the PRESIDENT (Mr. E. T. Pickering) presiding.

The temperatures to be measured on a gas-works range from atmospheric, or sometimes below, to round about 1,400° C. In testing, higher temperatures are used.

The apparatus used may be divided roughly into the following groups:

(1) Thermometers or expansion instruments for temperatures up to about 500°-600° C.
(2) Electrical methods, such as thermo-couple and resistance pyrometers for use up to 1,000°-1,200° C.
(3) Optical methods for use from 700° C. upwards without limit.
(4) Radiation methods for use from 700° C. upwards.
(5) Fusion methods, such as Seger cones, &c., from 600° C. to 2,000° C.

Thermometers.

The usual type is the mercury in glass thermometer. By using special glass and confining the mercury under a pressure of nitrogen, the range of these instruments can be extended to about 500° C. They are fragile and it is not safe to use them in any critical position without checking their accuracy. There is a slow change in the glass after manufacture, and if great accuracy is desired, checking at intervals is necessary. The more robust mercury in steel thermometer is preferred. Since in this case it is not possible to see the expansion of the mercury, other methods have to be adopted to give the temperature indication, the usual one being an application of the Bourdon tube as used in steam gauges. This makes indicating and recording a comparatively simple matter.

Our experience has been with the recording type, and the chief practical points to be noted are:

(1) The recorder should be fitted in a rigid vertical position at a place where the temperature is fairly constant.
(2) The capillary should be bent in curves and there should be no bending near the recorder or the bulb.
(3) Excessive inking, by far the most common fault, should be avoided. It is probably not realized that the longest line required is only about 30 in. per day, and as the ink does not dry up, very little is required. The excess which is usually added runs down the pen arm on to the pivots, causing corrosion of the former and stickiness at the latter. The obvious precaution of putting the nib at the bottom of the arm has been adopted by some firms.
(4) The pen arm is set to give the minimum of friction consistent with the necessary pressure to draw a line on the chart, and some delicacy of touch in removing the chart plate for chart changing purposes is therefore obviously necessary.

Generally these instruments have proved reliable to use and have given a minimum of trouble. A type akin to these is the vapour pressure thermometer, which is really a boiler and a pressure gauge. These have certain advantages over the mercury in steel instruments in that the length of capillary does not affect the readings nor does variation in the temperature of the Bourdon spiral, but in our experience they have not proved as reliable.

In this group mention must be made of bimetallic strip thermometers. Their use is usually confined to recording atmospheric temperature changes, chiefly because of the difficulty of making adequate checks, and of correcting where checks have shown a too compressed or too expanded scale.

Electrical Methods.

The Resistance Pyrometer.—A pure metal changes its electrical resistance with change of temperature. Consequently it is possible to measure a change of temperature by change of resistance. The metal usually employed is platinum, though for temperatures up to 300° C. nickel is used, as exemplified in Fairweather calorific value recorders. The indicator portion is an electrical apparatus for measuring resistance. The resistance of platinum wire is very easily affected by other factors as well as temperature changes. It is essential that no impurity be allowed to come into contact with the wire. Silicon is a bad offender, and as silica at high temperatures in reducing conditions readily becomes silicon, the provision of a suitable gas-tight sheath becomes difficult. The accuracy of the instrument is also affected by bad contacts, broken strands of wire, and especially by moisture.

The accuracy is spoiled should the leads be unequally strained, in illustration of which it may be mentioned that the sag in a length of conduit carrying such leads due to the accidental removal of a support was sufficient to alter the accuracy of the outfit several degrees, until the zero was reset. For these reasons the use of resistance pyrometers on the works has been discontinued, and they have been reserved for standardization and checking purposes, for which they are eminently suited.

Thermo-couples.—These may be of base metal or of rare metal. Examples are:

(1) Iron *v.* constantan (for use up to about 800° C.).
(2) Chromel *v.* alumel. (Hoskin's alloys.) For use up to about 1,000° C.
(3) Platinum *v.* platinum + 10% rhodium. For use up to 1,200° C.

The temperatures given are those for which a useful working life may be expected.

It is useful to remember that a base metal outfit is usually a low resistance circuit, the indicator being comparatively robust, whereas the rare metal outfit is a high resistance circuit with an indicator having a delicate suspension. Works practice is almost entirely confined to base metal installations. The following points are worth stressing:

(1) Since the indicator is designed to read correctly with a circuit whose resistance is fixed within close limits, bad contacts are to be avoided.
(2) If replacement of the couple or leads is necessary, it must be by others of the same resistance. Should the ends of the lead become frayed, the removal of the frayed portion should not be resorted to without due consideration as to the effect on the overall resistance of the circuit.
(3) If several couples are arranged to read on the same indicator, avoid the use of a common return and use really heavy switches for making connections.
(4) The couple should be immersed to a sufficient depth to counteract conduction of heat along the wires. Usually half to two-thirds of the couple length will need to be immersed.
(5) These installations have been found to be very reliable, the chief troubles occurring in the indicator usually due to the ingress of dust, which, settling between the moving coil and surrounding magnet, causes the pointer to stick. Faulty readings in another case were traced to an unbalanced pointer.

Fibres on the scale edge sometimes have caused sticking of the pointer under certain conditions only —*e.g.*, the pointer may be free when tested horizontally and yet stick when in a vertical position.

Instead of an indicator a recording mechanism may be employed. Since the force moving the pointer is extremely small, the usual recording pen cannot be employed. The position of the pointer is recorded by a mechanism tapping it on an inked thread so leaving a dot on the chart immediately below (as in the thread recorder) or by tapping on the chart via a carbon paper, the pointer being free to swing for most of the time.

Where a thread recorder is used, similar trouble to that mentioned above for indicators has been caused by fine filaments on the thread projecting, giving a jerky movement to the pointer. A thread made of plaited artificial silk gives the best results.

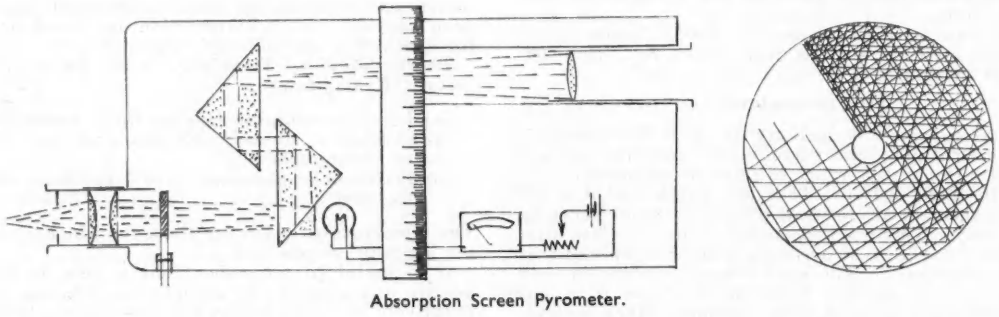
Optical Pyrometers.—One pyrometer of this type makes use of a minute spot of light from a standard lamp, superimposed on the image of the hot body which is formed in the eye-piece. A photographic film on a glass disc capable of rotation, which increases in density progressively round the disc, serves to cut down the intensity of light from the furnace until the standard spot cannot be distinguished in the general background. The position of the disc on a circular scale gives the temperature reading. The standard lamp is fed from a dry cell via a rheostat and a milliameter all contained in the body of the instrument,

which is therefore compact and handy—important considerations in retort house work.

We have found, however, that this compactness has been attained by employing items of construction which are not beyond reproach—*e.g.*, the dry cell is not steady in voltage. Each time the pyrometer is used the switch must be held down for a few minutes, to allow the voltage to fall to a reasonably steady figure. The rheostat can then be adjusted to give the correct calibration point. When in use in the retort house this calibration point will need adjustment owing to the slow fall in voltage, an effect which is to some extent counteracted by a rise in voltage due to the general warming up of the instrument.

The press switch is a source of trouble, the slight differences in contact making it difficult to be sure that the correct calibration point is being obtained.

A third trouble has been a slow alteration in the photographic film necessitating re-calibration. Very small pinholes in this screen were a nuisance until they were blotted out with dots of Indian ink.



Absorption Screen Pyrometer.

In spite of this catalogue of trouble, the compactness of the instrument and the ease with which the standard spot could be made to disappear has made for it many friends.

In another type of optical pyrometer the brightness of a standard lamp is varied by means of a rheostat until the centre of the filament cannot be seen against the background of the furnace. This type is widely used. Essentially the objective lens focuses an image of the object sighted, in the plane of the lamp filament. The image and the filament are viewed through an eye-piece lens containing red glass. The lamp filament is preferably sharply M-shaped, the bottom of the V being on the optical axis. The lamp is fed generally from an external accumulator, and the brightness of the filament is varied by means of a delicate rheostat on the instrument. The current passes through a moving coil ammeter also on the instrument, which is calibrated directly in degrees.

Troubles which have shown up with this class of instrument are:

(1) Dust on the optical faces has been known to cause an error of as much as 40° low. It is very important to see that the objective glass and high range screen if fitted are really clean. In one make of pyrometer this screen is pivoted in front of the objective lens and here it is necessary to wipe both sides of the screen. Wiping should not be done with "any old rag."

Dust getting in the rheostat gives a jerky pointer. Dust getting in the moving coil instrument also gives a sticky movement.

(2) Fine fibres on the scale may stand up and cause sticking of the pointer at some point. The composition pointer stops also tend to hold the pointer sometimes, making it reluctant to leave the lower stop.

(3) A very important point indeed is the correctness of balance of this pointer. The positioning of the various sighting places in the retort house necessitates using the instrument at almost every angle possible, and an unbalanced pointer can give very wrong readings. For a given rheostat setting the reading should be constant however the pyrometer is held.

(4) Connections to the battery lead can be a great nuisance if not robustly designed for rapid connection and disconnection. Such connections should be placed well away from where the instrument is normally gripped in the hand; a good switch here would be an advantage. Trouble difficult to locate is caused by breakage of strands of wire in this connecting lead.

All optical instruments depend finally upon the observer for the accuracy of the readings, and anything which lessens the fatigue of using the instrument is an advantage. The provision of rubber eye-shields is almost a necessity for observers who wear glasses. The observer should avoid straining his eyes by looking at bright objects before and during the taking of a series of temperatures. Designers of settings can help very considerably by arranging that sighting holes shall be in reasonably accessible positions, and the view not obscured by tie rods, &c. It is obviously not conducive to accurate work when the observer has to sight on a series of holes all a matter of 15 in. or so above the level of the platform on which he is standing. There have been cases where it was only possible to sight on a particular flue by lying on the waste gas flue, or by standing in several inches of filth. Admittedly, such cases are exceptions, but the result of that sort of thing cannot be other than a lower efficiency of retort house control. Generally, optical pyrometers are accurate to about ±3°, and results are reproducible within 5° C. It should be noted, however, that even if block body conditions prevail at the point sighted, highly luminous flames intervening will give high results, and conversely the intervening presence of smoke will give low readings.

Total Radiation Pyrometers.—In pyrometers of this class the whole of the radiant energy received from an area is brought to a focus on the junction of a small thermo-couple, and the E.M.F. developed is measured on a millivoltmeter. Generally speaking, these instruments require too large a sighting hole, and the accuracy of reading is very readily affected by the presence of smoke, dust, carbon dioxide, and water vapour between the instrument and the object sighted on. Our experience of instruments of this type has been confined to older patterns, which have been used simply for maintaining a furnace temperature constant at a value determined by other pyrometric means.

A very interesting recent addition to this class of instrument is the phototube pyrometer. Here the couple is replaced by a light sensitive cell. The output of this tube is amplified in a valve circuit, and the result indicated on a milliameter or recorder. Calibration has to be carried out against a standard pyrometer. The principal advantages offered by this instrument are an almost instantaneous response to temperature change of the source and their great sensitivity.

Checking of Instruments.

For thermo-couple installations checking may be done *in situ*. The procedure is as follows:

(1) Make sure connections are clean and tight.

(2) Remove the couple from the furnace and put into a deep tube containing naphthalene which is boiled by a small portable primus stove. The couple stem should be about half its length immersed in the vapour. If the reading is correct, probably all is satisfactory. If incorrect, note the reading.

(3) Check zero setting which should be the temperature of cold junction and examine leads for polarity. The leads are distinctly coloured by the makers, and it will be remembered that the metal in the leads is the same as that to which it is connected in the couple.

(4) If error persists change the couple for another one known to be correct. If reading is still as in No. 2 the fault is in wires or indicator. If reading is different but still incorrect, then there are faults in couple and in leads or indicator.

(5) Remove indicator to laboratory and set up a circuit with correct external resistance and couple and test in boiling naphthalene vapour. If reading is now correct the leads were faulty. If still the same as No. 2 it is the indicator at fault. If incorrect and

different from No 2 there are faults in lead and indicator.

If the E.M.F. at terminals V deflection calibration be known, the indicator need not be removed, and a potentiometer may be used to take the E.M.F. across the terminals while the indicator is still in circuit. From the result and the calibration chart the correctness or otherwise of the indicator is known. It must be remembered that the potentiometer will give a correct figure whether the leads are of one or 1,000 ohm resistance.

(6) The correct polarity of the compensating leads can be checked by disconnecting the couple, and shorting the lead ends and warming them, when the pointer should rise.

Faults in the indicator are usually due to:

(1) Dust between the magnet and moving coil.
(2) Fibres on scale causing sticking of the pointer in certain conditions.
(3) Unbalanced pointer.
(4) Pivot wear in an old instrument.

Procedure in the Laboratory.—Standardizing is carried out by the National Physical Laboratory. We check our instruments by comparison with a Standard instrument, and by the use of "fixed points." In order to appreciate this it is necessary to consider the Fundamental Scale of Temperature.

Kelvin formulated a scale of temperature, which was independent of the intrinsic properties of any particular substance, and which would be identical with the scale given by a "perfect gas." The "perfect gas" is defined as one in which the expansion (which defines the temperature), whether under constant volume or pressure, would increase exactly in proportion to the quantity of heat required to produce it. No gas is perfect, but hydrogen, helium, argon, oxygen, and nitrogen are very nearly so, and the difference from perfection can be calculated, being of the order of 1° at 1,100° C. for air or nitrogen.

The gas thermometer is never used for practical work, and the gas scale is transferred to auxiliary standards, such as the various fixed points, the melting and boiling points of pure substances. The platinum thermo-couple is compared with the gas scale and can then be used as a secondary standard.

The Law of Stefan Boltzman concerning total radiation and that of Wien concerning the intensity of radiation for a given wave length have been exhaustively studied, and found to agree up to 1,550° C. with the gas scale and with themselves as far as has been reached.

The results of all these researches are embodied in the following examples of "fixed points":

Temperature, °C.	Substance.	Uncertainty.	Atmosphere.
217·9	Naphthalene (B.P.)	0·02	Air
444·5	Sulphur (B.P.)	0·1	,,
801	Salt (NaCl) (M.P.)	2·0	,,
1,063	Gold (M.P.)	2·0	,,
1,391	Diopside (pure) (M.P.)	..	,,
1,452	Nickel (M.P.)	..	Hydrogen or nitrogen
1,549	Palladium	3·0	Air

Mercury-containing Instruments.—In the case of mercury in glass thermometers, the freezing and boiling points of water are used as the fixed points, and intermediate points are checked by comparison with an N.P.L. checked thermometer. For mercury in steel instruments the boiling points of water and naphthalene are used as the fixed points. Intermediate points are compared with a standard resistance thermometer or a standard couple. If the instrument is correct at three fixed points there is probably no need for further comparison.

Standard Couple.—This is a platinum-platinum-rhodium couple. It is purchased with a batch number, the E.M.F. V. temperature curve for which is given by the makers. This curve is very nearly a straight line, but is actually composed of three curves:

(1) . . . . . 0°– 400° C.
(2) . . . . . 300°–1,200° C.
(3) . . . . . 1,100°–1,750° C.

Equations have been found which fit each of these sections well, but no one equation fits all three.

The standard couple is used in conjunction with a potentiometer and the outfit is checked at the boiling point of naphthalene and sulphur, and at the melting point of gold. Probably the E.M.F.'s found at these fixed points will differ from the expected figures as read off on the Temperature E.M.F. graph supplied with the couple, but the percentage difference in each case will be constant, enabling a factor to be used to correct any intermediate E.M.F.'s. This overall correction factor will change very slightly with time, due to slight change in standard cell, &c. Should, however, the percentage difference at these fixed points vary, the couple is at fault and must be rejected.

By reason of the composite nature of the curve as given above, it will be realized that the above factor will enable us to check any temperature up to the melting point of gold with certainty. While it is safe to interpolate, it is not safe to exterpolate beyond 1,200°, the limit of the second portion of the curve. In order to use the couple at higher temperatures than this, it would be necessary to check the third portion of the curve by means of some fixed point within the range, and this is not easy to do. This standard couple can be used to check or (if necessary) standardize base metal couples, or check optical pyrometers.

Optical Pyrometers.—These are used for a range of 700° to about 1,450° generally. For special work they may be required to read temperatures up to 1,700° C. As stated above, by comparison with the standard couple they can be fully checked up to 1,200° C. Higher than that temperature we have no fundamental check, and it is useful to consider in what way the accuracy can alter.

The following points of the instrument can alter:

(1) The lamp, due to ageing.
(2) The milliameter, due to weakening of control system.
(3) The scale, due to shrinkage.
(4) The absorbing screen (if that type of pyrometer).

The importance of checking at the melting point of gold will now be realized as the last definite landmark. By adjusting the zero of a disappearing filament pyrometer to give the correct reading at 1,063° C., we overcome errors due to lamp and ammeter, and assume that the scale calibration is correct for all higher temperatures. This assumption is fairly safe in that we can compare the scale readings with the standard couple up to 1,200°, which will show up any defects. In the case of pyrometers using an absorbing screen we are on more dangerous ground, since it is found in practice that the screen alters unevenly.

The desirability for a higher standardizing point than that of melting point of gold is apparent, or alternatively optical pyrometers may be checked against a similar instrument standardized by the N.P.L. and kept solely for checking purposes.

Apparatus Used.

For glass thermometers up to 100° C. the thermometer in question, together with the standard, is put into a lagged vessel of water which is kept in vigorous agitation by means of a current of air. By warming this air the water temperature is slowly raised, and the thermometer are readings compared.

For mercury in steel thermometers, or glass thermometers of higher range apparatus for boiling water, naphthalene, and sulphur is used. The water boiler is made of copper. The naphthalene and sulphur boilers consist of a lagged iron tube, closed at the bottom, about 3 ft. long, and standing on legs of suitable height. Within this tube is a second tube extending to within 6 in. or so of the bottom. The purpose of this is to remove most of the error which would result from radiation from the hot bulb to the cooler wall of the tube. A cage made from sheet aluminium is slipped over the bulb (or ends of the thermo-couple) when the sulphur boiler is being used, to prevent cooling by the condensed sulphur running down from above. The rate of boiling is adjusted so that the upper 10 in. or so of tube, which is unlagged, serves as condenser.

The standardized platinum couple is 12 in. long, and, as stated, the E.M.F.'s developed are measured on a potentiometer. The couple is used bare, and E.M.F. is determined in naphthalene vapour (218° C.) and in sulphur vapour (444° C.). The freezing point of salt (801° C.) is the next checking temperature, and to determine this, some 2-3 in. of the bare couple is immersed in the molten salt and the time-temperature cooling curve is plotted, the freezing temperature coinciding with the horizontal portion of the curve.

The final checking point, that of the melting point of gold, is carried out in a special furnace designed for the purpose of checking optical pyrometers. In this furnace the couple is mounted inside an alundum tube, the hot end of the couple being about ½ in. from the inner end of the tube, and being kept central therein by means of an alundum cylinder through which the couple passes. The hot junction is immediately in front of this cylinder. The whole couple unit is slipped into an alundum tube (1½ in. in diameter) furnace, which is platinum strip wound on the outside of the tube. The hot junction is central in the

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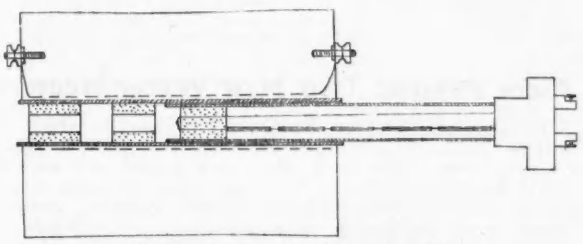
furnace. The front part of the furnace tube carries two or three short lengths of alundum tube, each about 1½ in. long, and spaced about ½ in. apart. These stop air circulation and give a more uniform temperature distribution round the couple junction.

For the gold check, about ¼ in. of pure wire is cemented to a fragment of refractory tube, and placed as close to the couple junction as possible, and the refractory pieces are replaced. The couple is connected by compensating leads to the cold junction, which is immersed in oil in a Dewar flask cased in wood. From here copper leads go to the potentiometer.

The furnace temperature is raised gradually, and the rising E.M.F. followed on the potentiometer. An optical pyrometer is mounted on a stand and focused on the wire. It will be realized that the wire is being viewed under black body conditions. When the temperature is about 1,030° C. the rate of increase must be very slow indeed, and it is advisable to make observations of potentiometer and wire each alternate minute, booking the readings. The wire melts very suddenly, and unless the method outlined is followed, the melting will certainly be missed.

By this means we check our standard couple for use up to 1,200° C. and also provide a fundamental check on our optical pyrometer, the importance of which will be appreciated from what has been said before in the preliminary considerations.

The furnace can easily be held at the temperature of the melting point of the gold, and other pyrometers can



Checking Furnace for Thermo-Couples.

now be similarly checked. By adjustment of the zero these instruments can be altered to read 1,063° C. at this temperature.

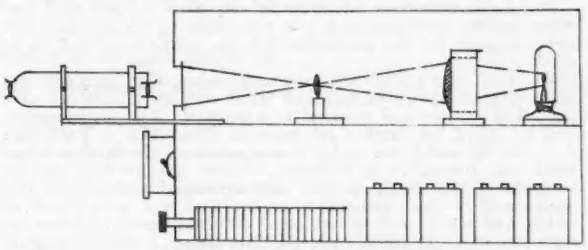
The standard couple, having been thus verified, may now be used to measure temperatures up to 1,200° C. The furnace temperature is altered to some intermediate figure and held steady, while the optical pyrometer is sighted on the couple junction, and its reading obtained. By this means accuracy of the scale and screen (if of that type of pyrometer) is checked.

For rapid checks on optical pyrometers the following apparatus has been designed: A 12-volt 100-watt projection lamp, which has been run previously at its full voltage for some hours, is mounted so that the filament is on the optical axis of a condenser and a double convex lens. The lens is placed a distance equal to its focal length from the condenser. The lamp position is adjusted until the light is focused by the condenser at the lens. A clear-cut image of the condenser of nearly uniform intensity is thrown on to a ground glass screen. These optical parts are secured in the upper compartment of a box, the lower one being used to house four 2-volt cells and a rheostat. On the front of the lower compartment are mounted an open scale voltmeter and a switch. An external trickle charger is connected to the cells. The front of the upper compartment carries a special clamp, so that the pyrometer to be checked can be placed in one position exactly, with ease. If a steady D.C. supply were available the Bointalite lamp would probably be satisfactory, instead of the projection lamp.

After a pyrometer has been checked against the melting point of gold it is then placed in the clamp, the light switched on, and the voltage adjusted to six.

Three or four minutes' burning allows conditions to steady, and the voltage is finally adjusted to six, and the apparent temperature determined, by two observers. The figure obtained is marked up, and it is then an easy matter to re-check this pyrometer at any time. It must be noted that this figure is for one make of pyrometer only.

Base Metal Couple.—The temperature E.M.F. relation of these being very nearly a straight line it is sufficient to check at one point, usually the boiling point of naphthalene. It is preferable to use the couple bare, immersing half its length in the vapour. Where it is not possible to remove the sheath a greater immersion is necessary to counteract the cooling effect of air circulation in the sheath. In order to provide a more complete examination a furnace has been designed whereby the full length up to 4 ft. of couple can be immersed in a heated tube, the air in which is kept circulating by means of a fan, and the temperature of which is taken at three points by three fixed



Optical Pyrometer Check Apparatus.

platinum resistance thermometers. By this means uniformity of temperature is striven for and complete checking of the base metal couple will be possible up to about 700° C.

Discussion.

The PRESIDENT (Mr. E. T. Pickering) said that the measurement of temperatures was one of the utmost importance in the correct control of gas-works plant. Generally speaking, in order to get the high efficiency demanded, it was essential to work near the safety limit of the refractories, and it was, therefore, necessary that pyrometers should be frequently checked otherwise there was a loss of therms and throughput. The same applied to waste-heat boilers, condensers, station meters, &c.; if they were to be worked economically, the temperatures must be accurately known. It was becoming more and more important to have efficient means of determining these temperatures.

With regard to thermo-couples, in his opinion, these should be immersed so that the greater portion of the length was in contact with the material of which the temperature was required to be measured. With a 6 ft. thermo-couple, it was necessary to immerse at least 5 ft. in order to get an accurate reading. He was interested in the effect of colour blindness on the proper taking of temperatures, and he thought it might be difficult for a person so suffering to match intensities.

Mr. A. H. ATTWOOD (Coventry), in proposing a vote of thanks, said the Paper should prove invaluable to the men who were using temperature measuring instruments.

Mr. F. A. JENKINS (Leamington), who seconded the vote, said he was interested in Mr. Haden's reference to a pyrometer working on the photo-electric cell principle, and thought that if the system could be developed it would give a reliable instrument.

At this stage, the PRESIDENT expressed the thanks of the Association to the following firms who had kindly loaned instruments and arranged for their representatives to be present at the meeting: The Cambridge Instrument Company, Ltd.; Ether, Ltd.; the Foster Instrument Company, Ltd.; and Negretti & Zambra.

Mr. T. F. E. RHEAD (Chief Chemist, Birmingham Gas Department) said that he had been able to draw on the considerable experience which the Chemical Staff of the Birmingham Gas Department had been accumulating over many years. They had many optical pyrometers in use for taking retort temperatures, and it was necessary to adopt the fairly elaborate system of checking. It was easy for such instruments to become misleading unless carefully and frequently checked. He referred to the error which could occur between two readers of the same instrument, and said that some people had no pyrometer complex. He emphasized the need for adopting an absolute standard. It was, of course, essential to have a N.P.L. pyrometer, but it was useful to be able to check even that occasionally—*e.g.*, on the gold point. He said that anyone taking temperatures in a retort house needed to be not only a skilled technician but to have the qualities of a salamander and a contortionist.

In Birmingham, they went to considerable lengths to get good temperature control, but it was very arduous work, and they did not get anything like as many temperatures as were really desirable.

In his opinion, the four groups of factors in retort temperature taking might be summarized as follows:—

(1) Weights and portability.
(2) Speed and accuracy of instruments involving amount of eye-strain.
(3) Endurance, skill, and judgment of operator.
(4) Heat, smoke, dust, &c., conditions existing at points where temperatures have to be taken.

In regard to the physical difficulty of taking temperatures, he felt that retort house designers and pyrometer manufacturers ought to get together more than they had done in the past, as there was a lot of ground to be covered in this direction.

Mr. W. HIND (Coventry) said he was impressed with the method of checking pyrometers and the amount of care taken. He asked whether so many optical readings were necessary, and if it were not possible to use high temperature thermo-couples for taking many temperatures. He referred to the

question of the length of thermo-couples it was necessary to insert in the furnace, and said that in his experience the best results were obtained when only about 4 in. was inserted.

Mr. E. F. CHARLES (Leamington) referred to the difficulty of taking temperatures in certain parts of the retort house, and pointed out how difficult it was to keep a pyrometer level when taking readings about 15 in. above a platform.

Mr. A. K. STEPHENS (Windsor Street, Birmingham) said that when buying instruments it was necessary to ensure that they were suitable for the particular job for which they had to be used.

Mr. F. J. BENGOUGH (Birmingham) asked why nitrogen was used in glass thermometers and what was its advantage over air. The Author had referred to a bimetal strip thermometer, and he asked for further information about this and whether it would be useful for meter thermometers. He further asked what was the effect of different sheaths and pockets on the readings of the thermometers, and instanced the case of two thermometers—one without a pocket and one with both of which had been checked but gave different readings when inserted in a gas main. He asked if Mr. Haden could recommend any particular thermometer for such a purpose.

Mr. W. D. CREEDY (Birmingham), referring to thermo-couple sheaths, said he sometimes thought these were like motor car spares—far too expensive. It had been found that nickel chrome sheaths proved most satisfactory for industrial purposes. So far as industrial gas appliances were concerned, he thought it would be quite true to say that the development of such appliances to their present state of efficiency had gone hand in hand with the advancement in efficiency and accuracy of temperature measuring devices. The pyrometer not only helped to control temperatures but also effected economy in the use of the apparatus.

Mr. D. W. G. SCOTT (Birmingham) referred to the effect of dust on the optical faces of pyrometers and expressed surprise that this could cause an error of as much as 40°. This, he said, made one wonder how far temperatures could be relied upon by this method, considering the amount of dust in a retort house. It seemed that the work of checking could be nullified owing to the presence of dust particles, and he thought the instruments should be taken to pieces periodically and cleaned inside.

Mr. F. H. BATE (Birmingham) made reference to the valuable aid of thermo-couples in waste heat boiler practice. He thought temperatures should be taken of the waste gases leaving the settings. If these were recorded when the setting as new, any increase which took place in the temperature of these gases bore relation to the amount of leakage which developed in the setting. Furthermore, in old types of settings some of the waste gas flues went underground, and if the temperatures in these flues climbed, serious damage might result in a position that was not open to observation, and any collapse in an underground flue might cause a cessation of working of the setting. He urged everyone who had control of settings which involved underground flues to keep a record of the temperatures existing in those flues.

Mr. A. R. MYHILL (Birmingham) stressed the importance of ease of operation and bodily comfort when taking temperatures in the retort house. The taking of a large number of readings, under conditions of heat and dust often prevailing in such situations was an arduous job, and however conscientious or willing the operator might be there was always a danger of slackness due to strain. He considered that any provisions for portability or rapidity of observations were worthy of very serious consideration by the makers of the instruments.

Pyrometer readings of flue or retort temperatures taken alone could lead to very misleading conclusions under certain conditions since it was very difficult to judge the distribution of temperature in a setting. This applied more to vertical flues than to horizontal ones. For instance, the temperature entered on the record sheet might extend over a band of 6 in., or it might be 6 ft. Unless the person taking the temperatures, as well as the person interpreting his figures, knew all the circumstances, erroneous conclusions might be reached. He suggested that more sighting positions in brickwork would be desirable.

Mr. Haden had said very little about the taking of comparatively low temperatures on the works—*i.e.*, such as were usually taken by means of a mercury-in-glass thermometer, as, for instance, temperatures of gas in mains. It was not desirable to adopt a too complacent attitude towards the figures given for such temperatures, since there might be many pitfalls. Such might arise by reason of, for example, conduction of heat to, or from, the thermometer. He instanced a particular case in which he had carried out experiments on a water-cooled gas condenser of the type where the hot gas entered at the bottom of one limb, ascended to the top, and proceeded down another vertical limb to the outlet at the bottom. By placing thermometers in the outlet main in various positions, it was shown that very erroneous results (up to 10° F. high) could be obtained by reason of heat conduction from the hot limb of the apparatus through the ironwork to the thermometer in the outlet main. Certain positions or methods of mounting the thermometer gave more reliable temperature readings than others.

The Author's Reply.

Mr. HADEN, in reply, said that in regard to colour blindness, sufferers from the complaint usually saw a greyish tint instead of the pure colour, but were still able to match the intensities. He had not met any bad cases of colour blindness.

He said that most people lacked confidence when first using the optical pyrometers, but that practice soon remedied this and readings were obtained with ease and precision. The method of "swinging" the filament first to the high side and then to the low side, reducing the "swing" until "match" was obtained, was recommended. The optical pyrometer check apparatus described in the Paper provided a very satisfactory way of becoming familiar with obtaining a match and of checking up on personal error.

He mentioned that the zero of an indicator should be set to read the temperature of the cold junction of the couple. Since this cold junction was generally arranged to be at the indicator terminals, this meant that the indicator zero was set to read air temperature.

With regard to the length of couple to be immersed in the furnace, if it were the furnace temperature that was required, half to two-thirds of the couple would need to be immersed to counteract the effects of conduction and of air circulation in the couple sheath, but under the particular conditions Mr. Hind had in mind the immersion of only a small portion of the couple would probably give a truer idea of the temperature.

In regard to the question as to the error due to taking temperatures of awkwardly placed sight holes with the aid of a mirror, he said that if the pyrometer were sighted on the mirror which was used to reflect the light from the flue then the accuracy would be equal to the reflection coefficient of the mirror.

Nitrogen was used in mercury thermometers because it was inert and would not cause filming. In regard to the best way of inserting couples, vertically or horizontally, horizontal gave less error due to air convection in the sheath but there was the trouble of sagging. Sheaths were made of nichrome steel, but a good chrome steel was satisfactory. As to how often optical pyrometers should be cleaned, he said that if the operator cleaned the screen and objective lens with a piece of cotton wool before taking a series of temperatures, the instrument would not need to be opened up for cleaning of the lamp, &c., oftener than every two months or so.

Ascot Present Two New Water Heaters

To introduce their two new water heaters, to which, it will be recalled, preliminary reference was made in these columns when they made their first appearance at the North London Exhibition, Ascot Gas Water Heaters, Ltd., on Monday, Nov. 29, welcomed to the Building Centre, Bond Street, architects, sales executives, and officials of gas undertakings and many others well known in the Industry, together with a large number of Press representatives.

The first of these water heaters, the "Ascot" boiling water appliance, Type RS 52/1, was shown in actual operation making cups of tea for those present. This heater is very similar in appearance to the normal sink heater, but is provided with a temperature selector marked "warm," "hot," and "boiling." If the control, which is situated between the two water taps, is set to "boiling" and the hot water tap opened, boiling water will be available in 40 sec. at the rate of 2½ to 3 pints per min. This boiling water is as pure as the water in the mains, and has to be boiling in order to be forced out of the appliance; there is no doubt, therefore, that it is really boiling. On turning the tap to "hot" very hot water, raised 100° F. from cold, is produced at the rate of ½ gal. per min. for washing greasy dishes, &c., irrespective of the amount of the opening of the water tap. To enable the user to obtain the great benefit of the instantaneous type of water heater—namely, to obtain water at any desired temperature by means of setting the water tap without any alteration of the gas controls, the temperature control is set to "warm" when very hot water can be obtained at the rate of ½ gal. per min., raised through 100° F. by opening the hot water tap slowly until the gas just lights, or cooler water may be obtained by opening the hot water tap further and increasing the flow to any desired temperature rise down to 40° F. at the rate of 1¼ gal. per min. The method of installation and regulation is similar to that of the "Ascot" sink gas water heater, Type R 12/4.

The other new appliance shown was the "Ascot" bath water heater Type SG 32/1, which represents a determined effort to get away from the ideas associated with the old-fashioned geyser. This heater is fitted with a chromium plated swinging spout, a water tap at the inlet, and, what is claimed to be a new feature—a winter-summer temperature compensator. This compensator consists of a porcelain knob projecting from the casing at the right, by the use of which the user is enabled to obtain really hot water at any time of the year, irrespective of the considerable variations in the cold water temperature in summer and winter, without the necessity of having the appliance readjusted for such conditions. The "Ascot" bath water heater gives a flow of 3½ gal. per min. raised through 40° F., corresponding to over 2 gal. raised through 60° F. A number of these appliances were tastefully arranged around the walls of the circular room in which they were shown, and, being floodlighted from below, presented a fine spectacle.

The Gas Companies' Protection Association

Fortieth Annual General Meeting

The Fortieth Annual General Meeting of the Gas Companies' Protection Association was held at Caxton Hall, Westminster, S.W. 1, on Friday, Nov. 26, 1937—Mr. F. G. BREWER (Vice-Chairman of the Committee) presiding in the unavoidable absence of Mr. R. W. Edwards (Chairman).

The SECRETARY (Mr. R. Girdlestone Cooper) read the notice convening the meeting, after which the minutes of the last Annual Meeting were read, confirmed, and signed.

Apologies for absence were reported from various members.

The VICE-CHAIRMAN (Mr. F. G. Brewer) referred with regret to the absence of Mr. Edwards and suggested that a letter be sent to him expressing their sympathy and best wishes for a speedy recovery. Mr. Brewer also referred to the death on the previous Sunday of Sir John Ferguson Bell, who had been a member of the Committee of the Association for some eighteen years, and he paid a personal tribute to Sir John's qualities. He thought he was right in saying that there were few names in the Industry more distinguished and none more respected than his, and he was sure it would be the wish of the meeting that a message of sympathy, on behalf of the Association, be sent to Lady Bell in her sad bereavement.

The Vice-Chairman moved the adoption of the Report of the Committee and Accounts for the year ended Sept. 30, 1937, and then read

THE CHAIRMAN'S ADDRESS.

which had previously been prepared by Mr. Edwards, and from which we take the following:

"One abnormal item causes the deficit in our Association's accounts for this year, and that is the heavy expenditure in connection with the proceedings before the Joint Committee on Gas Prices, to which I will refer in more detail later. This was an occasion for which we were well prepared, but it disturbed for once in a while the even tenor of our financial way. Your Committee, and, I trust, our members too, were well satisfied that the Industry received full value for the moneys expended.

You will observe from copies of the Report and Accounts which have been circulated to all members that in all other respects our receipts and payments are well up to normal and capable of meeting any ordinary combination of circumstances. Our reserves now stand at a substantial figure, and subscriptions and donations continue to be distinctly encouraging.

The Gas Industry.

On turning to that Industry in which we are particularly interested, I think I can say that we have continued to progress during 1937. In an Industry that has been in existence for over one-and-a-quarter centuries, and has developed steadily throughout that period, it would be unreasonable to expect spectacular increases in sales unless the undertaking was situate in an area where large industries using gas in their processes predominated.

The most important event, and one affecting us all, was the issuing of the Report of the Joint Committee on Gas Prices. Last year I dealt fully with the facts leading to the setting up of a Committee to enquire into the powers possessed by basic price companies of regulating charges. The result of the Committee's deliberations is, in my view, a new "Charter for Gas."

From the outset of the deliberations your Committee were resolved to take every advantage of the unique opportunity which then presented itself. The terms of reference concerned only company-owned undertakings, with whom the basic price and dividend system was becoming increasingly popular. For the purpose of supervising the direction of our case before the Committee, a sub-Committee of the Association was appointed consisting of the Vice-Chairman, Messrs. R. J. Auckland, Ralph Halkett, and myself. The legal details were delegated to our Parliamentary Agents, Messrs. R. W. Cooper & Sons, who retained Mr. Sidney G. Turner, K.C., and Mr. Maurice P. Fitzgerald as Counsel.

It was arranged to deliver one set of Briefs to all Counsel engaged for the Industry, apart from the South Metropolitan Company, and any extra expense was agreed to be borne by the National Gas Council and the Gas Light and Coke Company. There was also set up a joint Sub-Committee of the National Gas Council, the Gas Light and Coke Company, and our Association, to which we nominated as an additional representative Mr. R. J. Auckland—Mr. R. Halkett and Mr. J. Wesley Whimster (members of our Committee) having already been appointed by the National Gas Council.

I think you will agree that the policy of the presentation of one consolidated case had much to commend it. There was no duplication in the evidence submitted, and the proceedings were considerably shortened.

Your Committee were of opinion that any general application of the Wrottesley Clause could not do other than cause hardship to some members, and decided that, through its advisers, the facts should be brought to the Joint Committee's notice. You will remember that this Clause, which was recommended by the Departmental Committee on Gas Legislation, presided over by Mr. F. J. Wrottesley, K.C. (now Mr. Justice Wrottesley), provided for the decrease in steps of the authorized increase in dividends resulting from the sale of gas at large discounts, as the discounts became greater. It is pleasing to note that the Joint Committee appreciated the point to such an extent that they recommended exactly what we had in mind—that is, that each undertaking should be considered separately, and the scale fixed by the clause should be appropriate to the business and prospects of the undertaking.

At the moment it is not possible to say what the outcome of the Joint Committee's recommendations will be; but I hope that they have finally laid low the catch phrase so often heard that "we hold a monopoly." Whether legislation will be introduced to give legislative effect to the suggestions made we do not know, but your Committee are at the present time giving their most careful consideration to the Report. Should legislation follow we will press for inclusion of the whole of the recommendations and not only those with restrictive tendencies, although the recommended power to impose a special charge for stand-by supplies is already fully covered by Section 24 of the Gas Undertakings Act, 1934.

Since the Report was issued the L.C.C. have passed a resolution expressing their disapproval of the recommendation that we should be entitled to impose a minimum charge and the view that an opportunity should be given to local authorities from time to time to object to the "published price" then current. The Council drew attention to the lack of any provision whereby they could enforce a reduction in the "published price," should the costs of manufacture fall. So far as we are concerned, it would be most unsatisfactory if local authorities could raise objections to the actual selling price of gas and involve our undertakings in the great expense that must follow any enquiry of such a nature and the position of having no certainty as to the continuity of prices.

On the question of the minimum charge there could be no divergence of opinion between undertakers; we had always striven for equal rights in the competition with which we were daily faced, and, irrespective of whether the power was used or not, we should have this right. It would be grossly unfair to make a selection from the recommendations; in my view, legislation, if there is any, should include them all without exception.

The Chairman next referred in some detail to the judgment, already fully reported in the "JOURNAL," in the case of Egham and Staines Electricity Company, Ltd., *v.* Gas Light and Coke Company, and, after stressing its importance to the Gas Industry, he continued:

Quite recently the War Office, in the course of its investigations of the conditions existing in barracks, enquired into the possibility of substituting gas for coal,

either in whole or part, in married quarters. As some of us are well aware, many such quarters are already supplied with gas, but the object appeared to be to bring the conditions up to a much higher standard and to obviate the use of coal if gas supplies could be obtained on anything like a comparable basis.

At the moment the enquiry is to be restricted to three areas where new construction is contemplated, but it seems reasonable to assume that if these are satisfactorily handled a much greater use of gas by the War Office will follow. I trust, therefore, that every effort will be made by those interested to acquire so useful a load.

A great deal of consideration has been given to the problem of the precautions to be taken in the event of air raids. As you know, special officers have been appointed and elaborate plans worked out by many local authorities, but much of the work has been delayed until the important question has been settled as to who finds the money for carrying out the suggestions of the Home Office. We are very seriously affected in view of the proposals for the interconnection of mains and the duplication of plant and will continue to watch the position until satisfaction is obtained.

Coal Position.

At no time during the past five years has coal—the very lifeblood of our Industry—caused us so much anxiety as it does at this time. Prices continue to rise, deliveries are in some cases difficult, and, above all, the negotiations with the Secretary for Mines, with which I dealt in some detail earlier this year, have not resulted in that measure of protection we were led to believe would be given.

With the object of bringing prosperity to the coal mining industry, and in particular the miners, comprehensive powers have been granted to coal owners, and a veritable sales monopoly has been established; but there is not an effective safeguard for consumers. It is our view that the Government has so interested itself in this particular industry that it is not now able to deny responsibility for its conduct which is of so much importance to the national well-being.

No effort has been made to control prices in the public interest. One of the best methods I have heard advocated is the suggestion to set up an independent supervisory body, to be advisory in character and without any executive powers, but whose sole functions would be the safeguarding of the public interest and the fostering of efficiency in the coal industry itself. There has already been a suggestion to set up such a body connected with the iron and steel industry. This supervisory body, to consist of three men invested with the widest powers for obtaining information, should maintain a constant watch over the Industry and should be competent to tender advice to the Board of Trade on all questions related to the winning, distribution, and sale of coal. Prices should be such as to give a fair wage to the miner and a reasonable return on capital to the mine owner if his mine continued to be operated efficiently.

Many complaints have been made as to the operation of the committees of investigation, and even if they are reconstituted and strengthened, following the assurances given in the House of Commons by the Secretary for Mines, they cannot provide adequate protection to consumers. As a minimum of the Gas Industry's requirements on a reconstitution and amendment of the procedure I would mention:

i. Such committees should be composed of independent persons free from any sectional interests.
ii. Proceedings should be public.
iii. Information should be equally available to complainants as to the committee.
iv. Either party should have a right of appeal from any decision given by a committee to a central tribunal consisting of three independent persons.

That is how the matter stands at the moment, and there should be no cessation of our watchfulness on a matter of such great importance to us.

British Gas Federation.

Another year of unremitting attention to our needs marks the satisfactory conclusion of the Federation's third year of existence—a year that has served to enhance its dignity and authority. The Federation was conceived in a difficult period and has already had a tempestuous but successful time in connection with coal, chiefly in an effort to enlighten the public and to draw the Government's attention to the disadvantages which consumers of coal are faced at this time.

The Earl of Dudley, I am pleased to say, will continue his able Presidency of the Federation during the coming year, and your Association's representatives on the Council—namely, Messrs. H. E. Bloor, C. F. Botley, R. Halkett, the Vice-Chairman, and myself have all been re-nominated to serve for the year 1938.

(*a*) *British Industries Fair.*—Under the auspices of the Federation, a successful Gas Conference was held at Birmingham in February last. The programme, which was very full, included an official welcome by the Lord Mayor and President of the Chamber of Commerce. The Gas Section was again a prominent feature of the Fair and was well supported by the manufacturers.

A constituent member of the Federation raised the question as to whether it was desirable to continue the Gas Exhibit at the Fair in 1938 on the same lines as on former occasions. The view of the Federation Council was that it was most desirable for the Industry to be suitably represented by a Gas Industries Section at the Fair. In any event, arrangements for the next Fair were well advanced, and it was too late to make any material alteration for 1938. The Society of British Gas Industries was invited to submit proposals in connection with the 1939 Fair.

(*b*) *South Kensington Science Museum.*—At our last meeting I mentioned this matter, and I am very pleased to see how actively this, to my mind, important question has been dealt with. The general plan and much of the detail have been agreed by the Committee appointed, working in conjunction with the Museum authorities, and at the present moment the question of financing the project is engaging the attention of a Sub-Committee.

(*c*) *Building By-Laws.*—The Committee set up last year to investigate the proposed building by-laws from a national standpoint, on which we had representatives in Mr. F. G. Brewer and Mr. G. Stevenson, presented its report to the Council which subsequently approved it subject to any amendments proposed by The Institution of Gas Engineers.

The regulations covered a wide field and were both detailed and comprehensive. Their publication was being awaited by the Board of Trade, the Ministry of Health, and the Industry, and early in August copies were available. So great was the demand that the first edition was rapidly exhausted and further supplies had to be arranged. The Council felt that the regulations would go a long way towards improving the standard of installations and eventually would be adopted as the basis of by-laws in the country.

This Committee has accomplished a fine piece of work for which we all are very much indebted, and they have been asked to complete their task by revising the booklet published by the National Gas Council in 1930 dealing with the fixing of geysers—which booklet should now be brought up to date.

Conjoint Conferences of Public Utility Association.

(*a*) *Factories Act.*—When the Factories Bill was before Parliament, the Conference put down certain amendments to the definitions of " building operation " and " work of engineering construction " in order to obtain a statement from the Home Secretary as to the Government's intention with regard to these matters. Unfortunately, success did not attend these efforts, but some minor amendments were conceded.

The Bill became law on July 30 last and affects us to an appreciable extent as hereinafter defined, although it does not come into general operation until July 1, 1938.

The provisions are chiefly directed to gasholders and their examination and maintenance, although our Industry is presented with a splendid opportunity to substantially increase its load under the provisions relating to the lighting, heating, and ventilation of work places. Gasholders have to be examined externally at least once every two years and a proper record kept of certain prescribed particulars. Holders that have been in use for twenty years or more must have samples cut from the crown and sides and a report made and recorded. There are also provisions relating to the repair and demolition of gasholders. The regulations are felt to be reasonable in all the circumstances, and in any event would be carried out by prudent managers.

(*b*) *Rating and Valuation.*—The special Committee to which the Conference had delegated this difficult question has been very active in endeavouring to clear up some, at any rate, of the anomalies that do exist. In furtherance of this object, a deputation has waited on the Central Valuation Committee to explain the amendments to the law suggested in the memorandum they had drawn up.

The Central Committee, being desirous of ascertaining the support, if any, that would be forthcoming from the Rating Authorities, had suggested that the Conference got into touch with them. Owing to there being no central body or association representing these authorities, an approach was made to the Association of Municipal Cor-

porations which did represent many large Rating Authorities. Unfortunately the Municipal Association was not prepared to meet the Conference representatives on the plea that a long enough period had not elapsed to allow of the Central Valuation Committee's recommendations being generally adopted and that therefore any discussion would be premature.

Nothing remained but for our representatives to inform the Central Committee of the position and endeavour to encourage legislation along the lines of the Central Committee's proposals. I may say that it has been felt for some time that Rating Authorities in some areas were not acting on the recommendations and had little, if any, intention of doing so. The position is very unsatisfactory, and your Committee will give its attention to the problem.

(*c*) *Mains and Cables in Highways.*—It is gratifying to be able to record a little improvement in the discussions on this hardy perennial. The representatives of the Conference have met those of the Highway Authorities, and while agreement has not been reached, a considerable reduction in the area of conflict has been made. The Conference suggested that, where the Authorities deviated a road, altered its level or the type of surface, and a case could be made out for the possibility of damage or of cost to the undertaker, the Highway Authority should bear the cost of removing the mains.

The view was held that the County Councils and the Municipal Corporations were favourable to the suggestion, but the Urban District Councils felt that the financial obligations might be so heavy that they would be unable to shoulder them. The negotiations at the moment, therefore, are at a standstill until the Highway Authorities put forward an official suggestion which will enable us to proceed further.

In order to keep members of our Association well informed a circular was issued setting out the position. Unfortunately, as so often we find the case, certain Authorities had put forward a suggestion not quite in accordance with the true position by producing a clause based on that agreed by the negotiating Committee for acceptance by the promoters of Private Bills and Special Orders. Members were warned by our circular not to consider the insertion of any such highway clause so put forward, seeing that it cut across the whole principle for which we have so long negotiated—namely, that the proffered clause covered only such mains and pipes as were laid after the passing of the Act or Order. Such mains and pipes as were laid prior to that date were expressly unprotected, thereby making confusion worse confounded.

While on the subject of highways it is interesting to record the facts that two more County Councils had been so misguided as to introduce what they called "Road Opening Permits" and "Sanctions for road opening." Our attention was drawn by the Conference to a form of "Road Opening Permit" served on certain public utility undertakers by the Bucks County Council. Your Committee directed that a letter should be sent to members who supplied gas in that area reminding them of their rights in this direction. I would like to emphasize this point—that members owning authorized undertakings should ignore any of these forms of agreement, conditions, or permits, no matter by what name they are called, and that any members who feel in a difficulty about such forms should get into touch with our Secretary.

An instance of the same kind arose in the County of Nottingham though here it was called a "Sanction." Certain conditions and regulations were laid down for the breaking up of county roads and the reinstatement of trenches, and the County Council proposed to withhold their consent to those undertakers who would not agree to comply with their stipulations. I need only say that we do not submit to bureaucratic efforts of this nature which are nothing less than attempts to whittle away our statutory rights.

A very useful precedent, relating to mains and cables affected as a result of road diversions, was obtained by the Conference in the Staffordshire County Council Bill, promoted in Parliament last Session, whereby any necessary removal is effected at the expense of the County Council.

Public Lighting.

The whole question of public lighting has been under the most detailed investigation of the Joint Lighting Committee of The Institution of Gas Engineers and the Lighting Section of the Society of British Gas Industries. One of the objects of the investigation was the securing and maintenance of a co-operation of the closest kind between supply authorities and manufacturers. A report has been issued, and the recommendations contained therein are available to you all.

The publication is most opportune, for only this month the final report of the Departmental Committee on Street Lighting was issued. This Committee, you will remember, was appointed by the Minister of Transport in 1934. The chief points to which attention should be drawn are:

(*a*) All main traffic routes (that is, classified roads in built-up areas) should be illuminated at night to a standard that would permit drivers to proceed safely at 30 m.p.h. without headlamps.
(*b*) Street lamps should be lighted from dusk until dawn.
(*c*) The cost should be partly borne by national funds and responsibility for lighting and maintenance confined to larger administrative units than it is at the moment.

Roads are divided into two groups—the above-mentioned traffic routes and all other roads which the responsible authority decides should be lighted. I have no doubt that the British Commercial Gas Association and the Society of British Gas Industries will be in a position to advise the Gas Industry on any point of technical difficulty.

This year the Association of Public Lighting Engineers held their Fourteenth Annual Conference at Folkestone from Sept. 6 to 9 under the Presidency of Mr. C. I. Winstone, the Public Lighting Superintendent of the Gas Light and Coke Company.

The supply and manufacturing branches of the Industry co-operated to give a special display of modern public lighting by gas, showing the very latest practice and equipment.

Income-Tax.

(*a*) *Mills and Factories Allowance.*—Your Committee's attention was drawn to the fact that Inspectors of Taxes in different areas were not giving Section 18 of the Finance Act, 1919 (the Section dealing with allowances in respect of Mills, Factories, &c.), a uniform application; and our Sub-Committee came to the view that a reconsideration of the basis set out in our Association's circular of March 10, 1920, was necessary. Interviews and correspondence followed, and eventually official approval was given to the circular of which you all had a copy on Dec. 18, 1936. The application of this particular section has, however, been altered by the Finance Act, 1936 (Section 22).

The Finance Act, 1937, made further changes, but meanwhile interviews with the Inland Revenue Authorities were taking place, and members who might be affected should agree only provisional assessments until the application of the new Sections is settled by the Board of Inland Revenue. Any difficulty experienced by members should be notified to our Secretary.

(*b*) *Rates of Depreciation Allowances.*—In amplification of what I said under this head last year, I would inform you that a joint memorandum was prepared and submitted by the National Gas Council and our Association to the Revenue Authorities, following which an interview took place with one of the Principal Inspectors, when a satisfactory hearing was obtained. At the moment further information is being gathered from a number of companies in support of our case, when we hope to be able to settle this troublesome matter on a more equitable basis.

National Defence Contribution.

In the Budget proposals of April last the business community in this country was introduced to the very latest in devices for the attraction of additional revenue into the National Exchequer from those deemed able to pay, and this was presented in a guise designed to appeal to our patriotic instincts—namely, "National Defence Contribution."

Great opposition was aroused on the original suggestions, and so widespread was it found to be that the Government very wisely substituted a much simpler formula to achieve the desired effect. The later proposals were to impose a tax of 5% on the Schedule D profits where a trade or business was carried on by a body corporate and 4% in other cases.

In view of our position as public utility undertakers, whose dividends were rigorously controlled by Statutory enactments, exemption from the incidence of the tax was conferred on statutory gas undertakings. It should be observed, also, that moneys received by a holding company from subsidiaries which were public utilities were exempted; this applied whether such moneys were by way of dividends, fees for management, or services rendered.

Coke.

The question of the exporting of coke has recently become a matter of some importance, and there has been set up the Gas Coke Export Association whose aims and objects had the approval of the National Gas Council, and all undertakers who are exporters of coke are recommended to become members.

It is perhaps unnecessary to state that our Industry,

which has been allotted control through the International Cartel of the annual amount of 925,000 tons of coke, should support this Export Association wholeheartedly for the very good reason that if that amount were exceeded owing to operations outside the control of the Association the quota for the following year would be reduced by any excess of the preceding year.

The hope is expressed that the present scheme will be entirely successful and not allowed through lack of adequate support to follow previous efforts to reach an agreement of a satisfactory nature on such a difficult subject.

General.

Once again I have to record at the end of a busy year the eminent service rendered by our Secretary. The Report before you will give some idea of the variety of work handled by the Secretary. Behind this there are numerous instances of advice being given to companies on particular matters of a very diversified nature. It is something to mark the expiration of our forty years' active work in the Gas Industry. At one period there was a saying that a man "was too old at 40," but from what I can judge of our Association and the intimate relationship in which I stand with regard to it, it seems only to have reached full years of maturity and will, I trust, continue to give you that service which we have from experience come to expect as a natural course.

Apart altogether from the actual time and labour involved on the part of those members who serve directly on your Committee, there are a number of gentlemen who devote their time and talents to serving on various Boards, Councils, Associations, and Committees on which we have a representation. While on this subject, I should like to mention Mr. Dean Chandler (Chief Technical Officer of the South Metropolitan Gas Company), who was our representative on the question of gas water heaters (ventilation). On the Joint Gas Conference Committee in connection with the British Industries Fair, Mr. Belton, Mr. Stevenson, and myself gave our attention; and Mr. Belton and Mr. Stevenson also represented us at the Health Conference promoted by the Royal Sanitary Institute held at Birmingham in July last. Our representation on the Committee of the British Standards Institution was maintained by the late Sir John Ferguson Bell and myself. Of all the foregoing gentlemen I would like to say, on your behalf, how much we appreciate and thank them for the work they have carried out.

As I have pointed out before, vigilance must be the keynote of our work; at no time should there be a slackening off in our attention to those matters that will fall to be dealt with in the immediate future."

The VICE-CHAIRMAN then formally moved that the Committee's Report and Accounts for the year ended Sept. 30, 1937, be approved and adopted and that the Report be entered in the minues.

The proposition was seconded by Mr. J. B. BROWN (Wandsworth) and, there being no discussion, was put to the meeting and carried unanimously.

Re-election of Officers and Committee.

On the proposition of the VICE-CHAIRMAN, seconded by Mr. A. J. MUMFORD (British Gas Light Company), Dr. Charles Carpenter, C.B.E., was unanimously re-elected President of the Association for the ensuing year.

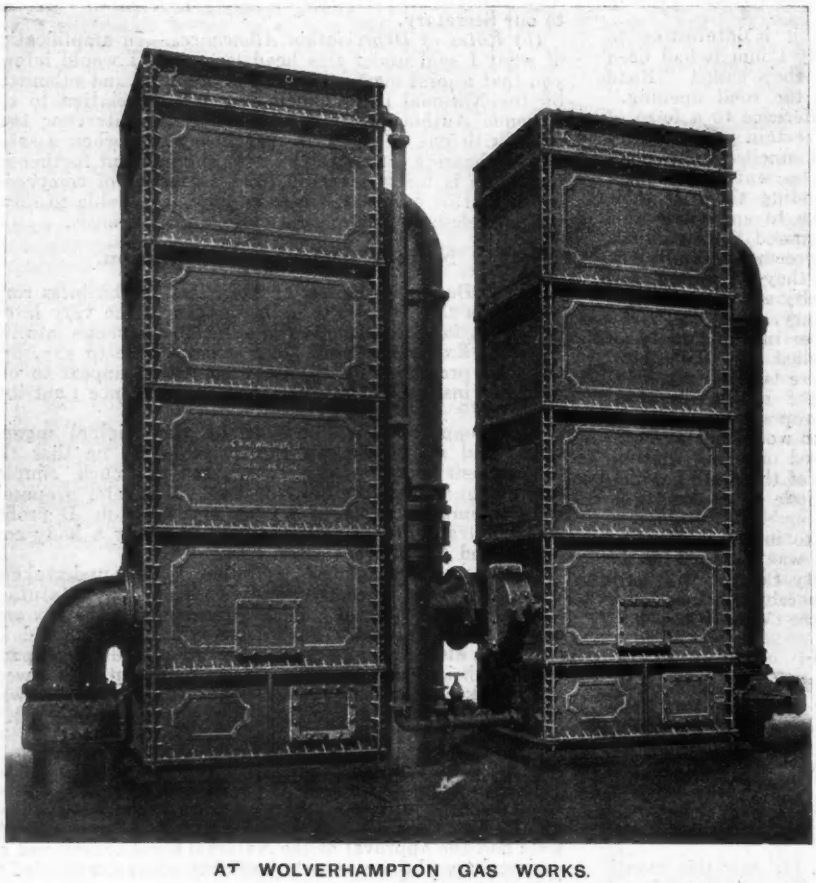
On the proposition of Mr. W. A. KING (Canterbury), seconded by Mr. D. H. HELPS (Reading), the following Vice-Presidents were unanimously re-elected:

Mr. R. Bruce Anderson.
Mr. F. J. Bradfield.
Sir Reginald G. Clarry, M.P.
Mr. A. A. Johnston.
Mr. Frank H. Jones.

On the proposition of the VICE-CHAIRMAN, seconded by Mr. R. J. AUCKLAND (Cardiff), the following members of the Committee retiring under Rule 12, and being eligible, were unanimously re-elected:

Mr. C. M. D. Belton.
Mr. E. J. K. Fussell.
Mr. Ralph Halkett.
Mr. A. J. Mumford.
Mr. Wm. Phillips.
Mr. Geo. Stevenson.

The retiring Hon. Auditor (Mr. Hyde C. Burton) was



AT WOLVERHAMPTON GAS WORKS.

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also reappointed, with a hearty vote of thanks for his services in the past year, on the proposition of Mr. E. J. K. FUSSELL (Tottenham), seconded by Mr. E. H. HARMAN (Commercial Gas Company).

Mr. FUSSELL thereafter moved a hearty vote of thanks to the Vice-Chairman for presiding over that meeting, at the same time expressing appreciation of the comprehensive resumé given by Mr. Edwards of the year's work.

The VICE-CHAIRMAN briefly acknowledged the vote and added an expression of thanks to the Secretary and his staff.

Athletic and Social

Cambridge Recreation Club's Social Evening.

With its employees scattered over a wide district, the social arranged by the Cambridge Gas Recreation Club proved not only a very happy entertainment, but also provided an opportunity to meet colleagues under most pleasant circumstances.

The programme was arranged by the indoor games section, which catered for a wide margin of tastes. Dances, old and new, competitions, games, and the introduction of variety features by capable local artistes contributed to what was generally agreed to be an outstanding function.

East Surrey Co-Partnership Meeting.

The general meeting of co-partners of the East Surrey Gas Company was held at the Market Hall, Redhill, on Nov. 25. Mr. W. Lees Stenning, J.P. (Chairman of the Board and of the Management Committee), presided, and he was supported by Messrs. W. H. Bennett (Vice-Chairman), R. Heath Mew, J. Urquhart, and A. E. Whitcher (Directors), J. R. W. Alexander (General Manager), Horace Long (Secretary to the Company and to the Committee), Ernest Scears (Chief Engineer), and Arthur Tennant (Sales Manager).

The Co-partnership Committee, in their annual report, recorded with much regret the death in March last of Mr. John Palmer, who commenced his service with the Reigate Gas Company in November, 1889. The number of co-partners on the register at June 30, 1937, was 258. The bonus and interest for the past year amounted to £2,436, and the amount deposited on Savings Account was £452. For the purposes of co-partnership the Directors allotted in September last the sum of £800 of Ordinary "B" Stock at the rate of £130 per £100 Stock. Co-partners had invested in the capital of the Company during the year the sum of £1,491. Up to June 30 last the amount of Ordinary "B" Stock acquired under the scheme was £17,260; and subsequent investments had brought the total up to £18,520, divided amongst 234 co-partners. The Directors had appointed the General Manager, Mr. J. R. W. Alexander, to fill the vacancy on the Committee caused by the illness of Mr. F. Wilkinson and his subsequent retirement from the service of the Company. They had also elected Mr. Ernest Scears, Mr. Arthur Tennant, and Mr. Robert J. Fuller to represent them on the Committee, together with Mr. Arthur Butterfield as Auditor.

The Chairman said that was the second time they had met without having their first Chairman, Mr. G. R. Hunt, with them. They would all agree that Mr. Hunt was an ideal Chairman. They all regretted his loss. He had left an honoured name; might they all follow his example.

Alluding to the retirement of Mr. Frederick Wilkinson, the Chairman said Mr. Wilkinson came to the Company in 1915. He became head of the distribution department, and from there he went in charge of the Dorking office. They all regretted his breakdown in health which had necessitated his retirement. They had lost a friend who was on the Co-partnership Committee for many years. Then Mr. Long had come up smiling after six months' absence, and he would like to express their thankfulness at his recovery. They also welcomed Mr. Alexander. They had read in the local Press of his many qualifications and he was not going to repeat them.

Proceeding, the Chairman said this was their twenty-fourth annual meeting. Starting with 70 members, the numbers had now grown to 258. During that period £27,150 had been paid over as bonus, and with the savings of co-partners and interest added, a sum of £39,000 had been dealt with. Co-partners held at June 30 last £18,520 of the Company's Ordinary Stock, representing an average holding of about £80 per head. He concluded by moving that the Committee's report and the statement of the Trustees' accounts be adopted. Mr. Bennett seconded the motion, which was carried.

Following this, the Chairman presented certificates for 25 years' service to Mr. John H. Ellwood and Mr. Sidney H. Tugwell. Mr. Alexander then presented the certificates and prizes awarded in connection with the technical classes.

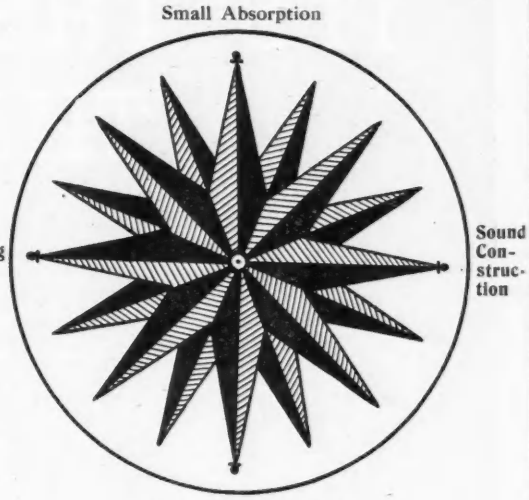
Mr. Whitcher proposed a vote of thanks to the Chairman, Committee, Trustees, Officials, and Auditors. Mr. F. S. Smith seconded.

Mr. Long expressed their thanks to the Directors for continued support of Co-partnership, their kindness in meeting them on those occasions. Their thanks were also due to Mr. Scears and his Committee for arranging the concert, as he had done so ably in the past.

The motion was carried with applause, and the Chairman, in acknowledgment, said as long as they pulled together as a team success was assured.

The meeting was followed by an entertainment to which wives and relatives of co-partners were invited.

All the Cardinal Points



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are specially designed for their work and register accurately, with a minimum of pressure loss under

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It's the needles that make the difference so noticeable in the Newton Needle Steam Heated Gas Heater. This use of needles on the element is a planned and patented principle. No other system can ensure a better heat transfer or a more negligible back pressure.

But these are not the only advantages. The elements are of a special cast iron so that you have no corrosion problems. Less tubes are necessary and less space is occupied. In actual fact the saving of space over other types is anything up to 40%.

The Newton Needle Gas Heater is built to last, so that considering how low is its initial cost, it is indeed an economical installation.

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STEAM HEATED GAS HEATERS
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Gas Markets and Manufactures

Stock Market Report

(For Stock and Share Lists, see later pages)

Last week the Stock Exchange commenced a slow and cautious recovery from the recent depression. Large investors began to absorb supplies available at the low prices, and in the absence of further shocks from abroad the average investor will doubtless gradually appear again. British Funds were well supported and closed fractionally higher. Leading industrials gained strength with the better demand for iron, coal, and steel shares. Brisk business was reported in South African gold shares and quotations responded accordingly, while prices in the metal and commodity markets began to harden. Towards the close the news from Wall Street was decidedly more cheerful, and if no further complications arise over the Far Eastern political situation, the current week should show an all-round increase in activity.

The number of recorded transactions in the Gas Market was slightly in excess of that of the previous week, and there were a few more price movements both up and down. In the Official List, Watford and St. Albans ordinary advanced 2 points to 142½ and, after a long reactionary period, South Metropolitan closed fractionally higher at 102½. A parcel of the latter stock is on offer at 103, yielding £3 6s. 9d.%. Apart from a few *ex* div. reductions, the only falls in this list occurred in Montevideo stock which dropped 3 points to 87½, while Tottenham ordinary lost 1 point at 134½. At the Provincial Exchange, Bristol closed fractionally higher, but at Newcastle a sharp fall of 5 points was experienced by Hartlepool consolidated stock.

In the list of ordinary stocks available at the time of writing are the following:

Amount Offering	—	Last Annual Dividend, %	Price.	Gross Yield %
£				£ s. d.
1,000	Associated Gas	5	20s.	5 0 0
1,000	British	7½	14s	5 1 4
2,000	Gas Light Units	£5 12s	25s. 9d.	4 6 10
2,000	Imperial Continental	10	142	7 0 10
1,000	Plymouth and Stonehouse	8	162	4 18 9
5,000	South Western Gas Corpn.	5	19s. 6d.	5 2 6
5,000	United Kingdom Gas Corpn.	5	21s.	4 15 3

Current Sales of Gas Products

The London Market for Tar Products.

Dec. 6.

There is little change to record in the London Tar Products market, prices being as follows:

Pitch, 38s. per ton f.o.b.
Creosote, 6d. to 6¼d.
Refined tar, 3¾d.
Pure toluole, about 2s. 4d.; pure benzole, 1s. 9d.; 95/160 solvent naphtha, 1s. 7d. to 1s. 8d.; 90/160 pyridine, 11s. to 12s.; all per gallon naked at makers' works.

Tar Products in the Provinces.

Dec. 6.

The average prices of gas-works products during the week were: Gas-works tar, 24s. 3d. to 29s. 3d. Pitch—East Coast, 37s. to 38s. 6d. f.o.b. West Coast—Manchester, Liverpool, Clyde, 37s. to 38s. 6d.* Toluole, naked, North, 1s. 8d. to 1s. 9d. Coal tar, crude naphtha, in bulk, North, 8d. to 8½d. Solvent naphtha, naked, North, 1s. 5½d. to 1s. 6d. Heavy naphtha, North, 1s. 3d. to 1s. 3½d. Creosote, *ex* works, in bulk, North, liquid and salty, 5d. to 5½d.; low gravity, 4⅝d. to 4¾d. Heavy oils, in bulk, North, 5d. to 5¼d. Carbolic acid 60's, 4s. 1½d. to 4s. 3d. Naphthalene, £14 to £17. Salts, 80s. to 85s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal; "B" quality unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.q. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Dec.* 4.

Business is still rather dull but it is anticipated that demand for 1938 will develop very shortly. Meantime prices are remarkably steady considering the lack of new business at the moment.

Crude gas-works tar.—Actual value is 37s. to 38s. per ton *ex* works in bulk.

Pitch remains rather uninteresting at 30s. to 32s. 6d. per ton f.o.b. Glasgow for export, and 30s. per ton *ex* works in bulk for home trade.

Refined tar is available at 3d. to 3¼d. per gallon free on rails for export, and 3½d. to 3¾d. per gallon *ex* works in buyers' packages for home trade.

Creosote oil is quite active at the following prices: Specification oil, 5½d. to 5¾d. per gallon; low gravity, 6¼d. to 6½d. per gallon; neutral oil, 5¼d. to 5½d. per gallon; all *ex* works in bulk.

Cresylic acid.—There is little or no new business but makers' prices are well maintained as under: Pale, 97/99%, 3s. 6d. to 3s. 8d. per gallon; dark, 97/99%, 3s. 3d. to 3s. 6d. per gallon; and pale, 99/100%, 4s. to 4s. 6d. per gallon; all *ex* works in buyers' packages.

Crude naphtha readily commands 6d. to 6¼d. per gallon *ex* works in bulk, according to quality and district.

Solvent naphtha.—90/160 grade is 1s. 5d. to 1s. 6d. per gallon, and 90/190 heavy naphtha, 1s. to 1s. 1d. per gallon.

Motor benzole is steady at 1s. 4d. to 1s. 4½d. per gallon.

Pyridine.—Prices are nominal at 11s. to 12s. per gallon for 90/160 grade, and 12s. to 13s. per gallon for 90/140 grade.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole	0 9½	to	0 10	per gallon at works
Motor ,,	1 3	,,	1 3½	,, ,, ,,
90% ,,	1 4	,,	1 4½	,, ,, ,,
Pure ,,	1 8	,,	1 8½	,, ,, ,,

Contracts Advertised To-Day

Electrical Switchgear.
Warrington Gas Department. [p. 826.]

Engineering Repair Shops Equipment.
Warrington Gas Department. [p. 826.]

Pipes and Specials.
Blackburn Gas Department. [p. 826.]

Portable Conveyor.
Bury Gas Department. [p. 826.]

Gas Undertakings' Results

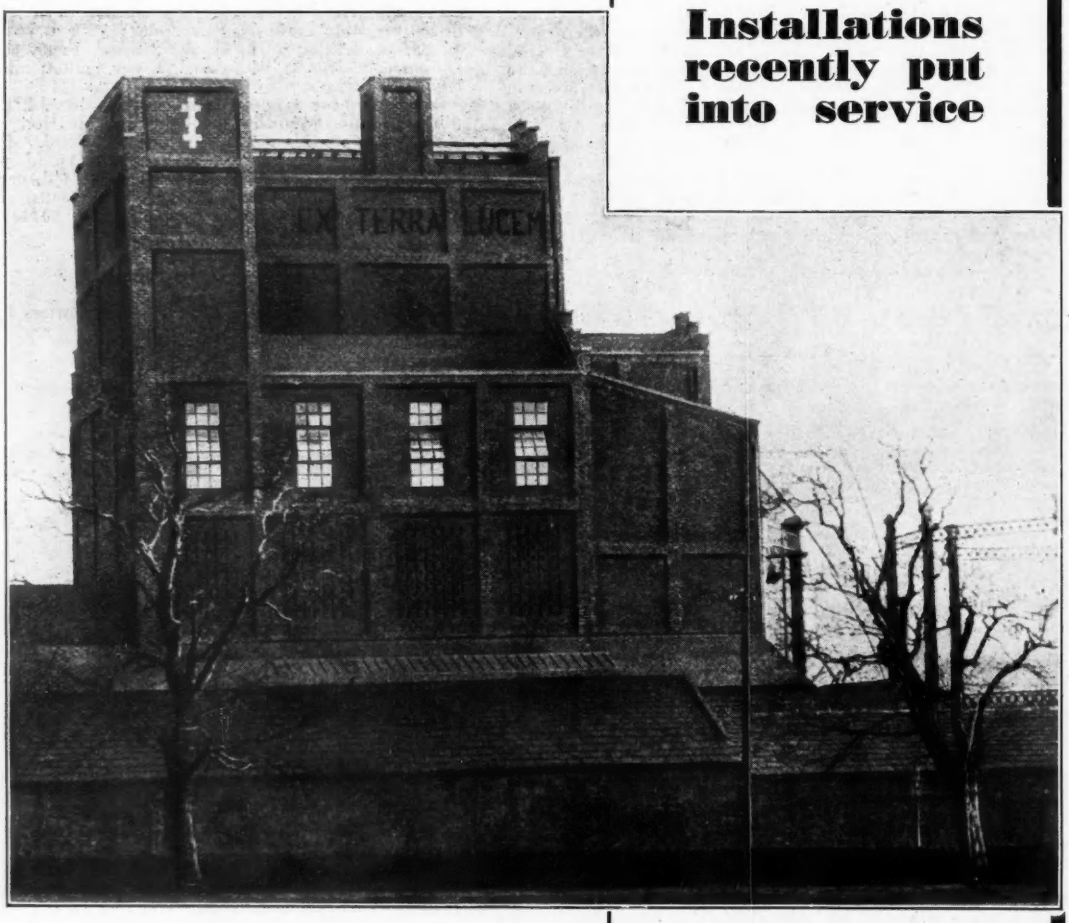
Danish Gas Company.

The Accounts of Der Danske Gaskompagni for the year ended June 30, 1937, show a balance standing to the credit of profit and loss account, after charging pensions, administration, expenses, renewals account, &c., and transferring Kr. 248,391.22 to the redemption accounts, of Kr. 686,003.55. Out of this sum the Directors recommend that a dividend of 6%, or Kr. 8.10 per share, be declared. This will leave Kr. 430,853.55 to be carried forward, an increase of Kr. 125,607.30 on the amount brought in. Capital expenditure of Kr. 88,400.79 for additional mains, services, meters, &c., has been incurred during the year, and necessary renewals and repairs have been carried out so that the works are in a condition to meet the demands upon them. A further amount of Kr. 100,000 has been set aside to renewals account against which has been charged Kr. 131,805.32, being the balance of the cost of the reconstruction of part of the carbonizing plants at Odessa and Ribnitz. The quantity of gas sold during the past year shows an increase of 3·77%.

THE WEST SYSTEMS OF MODERN GAS AND COKE MANUFACTURE

GLOVER-WEST
VERTICAL RETORTS

Installations recently put into service



Carbonizing plants ordered or started up during 1937 bring the total installations of West design up to 416. The total of retorts or chambers involved is 10,732.

YEADON Continuous carbonization in Glover-West vertical retorts was adopted by the Yeadon and Guiseley Gas Company for their works modernization scheme of 1934. Smokeless operation was an important factor in the decision. The extension to this plant which began operation early in the present year has increased its production capacity by 50 per cent.

WEST'S GAS IMPROVEMENT COMPANY, LTD.

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STOCK AND SHARE LIST

Official Quotations on the London Stock Exchange

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Dec. 3.	Rise or Fall on Week.	Transaction Lowest and Highest Prices During the Week.
1,767,439	Stk.	Sept. 6	8	8	Alliance & Dublin Ord. ...	161—166	...	165
374,000	,,	June 21	4	4	Do. 4 p.c. Deb. ...	95—100	...	...
558,890	,,	Aug. 9	7	7	Barnet Ord. 7 p.c.	158—163	...	159
300,000	1	Oct. 4	1/9⅓	1/4¼	Bombay, Ltd.	26/—28/-	...	26/6—27/6
179,915	Stk.	Aug. 9	9½	9½	Bournemouth sliding scale ...	200—205	...	...
590,407	,,	,,	7	7	Do. 7 p.c. max. ...	158—163	...	160—161
493,960	,,	,,	6	6	Do. 6 p.c. Pref ...	133—138	...	135—136½
50,000	,,	June 21	3	3	Do. 3 p.c. Deb. ...	79—84	...	80—80½
262,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	98—103	...	101½—102
335,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	115—122	...	...
357,900	,,	Aug. 9	7½	7½	Brighton, &c., 6 p.c. Con. ...	150—155	...	150—152
649,955	,,	,,	6⅔	6⅔	Do. 5 p.c. Con. ...	133—138	...	133—135
205,500	,,	,,	6	6	Do. 6 p.c. 'B' Pref.	127—133	...	...
855,000	,,	Sept. 20	8	7	British Ord.	145—150	...	146½
100,000	,,	June 21	7	7	Do. 7 p.c. Pref.	140—145	...	...
350,000	,,	,,	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	110—115	...	...
120,000	,,	June 7	4	4	Do. 4 p.c. Red. Deb. ...	95—100	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	102—107	...	...
450,000	,,	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1½—2½	...	...
100,000	10	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref. ...	1½—3½	...	...
150,000	Stk.	June 21	4½	4½	Do. 4½ p.c. Deb. ...	79—84	...	...
626,860	,,	July 19	6	6	Cardiff Con. Ord.	125—130	...	...
237,860	,,	June 7	5	5	Do. 5 p.c. Red. Deb.	107—112	...	...
98,936	1	Oct. 4	2/-	2/-	Colombo Ord.	1⅜—1⅞	...	...
24,510	1	,,	1/4½	1/4½	Do. 7 p.c. Pref. ...	23/6—25/6	...	...
739,453	1	Oct. 4.	-/11·48	-/11·48	Colonial Gas Assn. Ltd. Ord.	17/—19/-	...	...
296,144	1	,,	1/3·30	1/3·30	Do. 8 p.c. Pref.	22/—24/-	...	...
1,775,005	Stk.	Aug. 9	5	5	Commercial Ord.	82—87	...	82—83
620,000	,,	Nov. 29	3	3	Do. 3 p.c. Deb. ...	73—78*	−1	...
286,344	,,	Aug. 23	5	5	Do. 5 p.c. Deb. ...	113—118	...	...
807,560	,,	Aug. 9	7	7	Croydon sliding scale ...	140—145	...	...
644,590	,,	,,	5	5	Do. max. div.	108—113	...	110½
620,385	,,	June 21	5	5	Do. 5 p.c. Deb.... ...	113—118	...	...
239,000	,,	Aug. 9	5	5	East Hull Ord. 5 p.c....	98—103	...	...
185,355	,,	Aug. 9	6	6	East Surrey Ord. 5 p.c. ...	120—125	...	...
176,211	,,	June 7	5	5	Do. 5 p.c. Deb. ...	113—118	...	...
250,000	1	Nov. 15	7	4	Gas Consolidation Ord. ...	19⅝—21⅛	...	...
250,000	1	,,	4	4	Do. 4 p.c. Red Cum. Pref.	18⅛—20⅝	...	...
19,255,284	Stk.	Aug. 9	5⅜	5⅜	Gas Light & Coke 4 p.c. Ord.	25/—26/-a	...	25/1½—25/7½
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.	83—86	...	...
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	100—103	+1	101—102
2,993,000	,,	July 5	...	3⅜	Do 3⅜ p.c. Red. Pref.	101—103	...	101½—102½
8,602,497	,,	Nov. 29	3	3	Do. 3 p.c. Con. Deb. ...	77—81*	−1½	78½—80½
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	110—113*	−2	...
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb....	110—113*	1	111½—112½
700,000	,,	Sept. 6	3½	3½	Do. 3½ p.c. Red. Deb....	94—99	...	97
270,466	,,	Aug. 23	6	6	Harrogate New Cons. ...	115—120	...	...
213,200	,,	Aug. 9	6	6	Hornsey Con. 3½ p.c. ...	118—123	...	...
5,600,000	,,	Nov. 1	12	8	Imperial Continental Cap. ...	137—142	...	138½—141½
223,130	,,	July 19	3½	3½	Do. 3½ p.c. Red. Deb. ...	89—94	...	...
285,242	,,	Aug. 9	8½	8½	Lea Bridge 5 p.c. Ord. ...	170—175	...	...
75,000	,,	Nov 29	†10	†10	Malta & Mediterranean ...	145—155*	−5	...
392,000	—	Oct. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb. ...	100—103	...	...
231,978	Stk.	Aug. 23	5	5	M.S. Utility 'C' Cons. ...	101—106	...	...
968,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	96—101	...	...
360,075	,,	June 21	4	4	Do. 4 p.c. Deb. ...	97—102	...	99—99½
148,955	,,	,,	5	5	Do. 5 p.c. Deb. ...	115—120	...	...
675,000	,,	Nov. 15	†9	†6	Montevideo, Ltd.	85—90	−3	87—88
250,000	,,	Aug. 9	7½	7½	North Middlesex 6 p.c. Con.	147—152	...	149½
396,160	,,	Aug. 9	5	5	Northampton 5 p.c. max. ...	110—115	...	111—111½
300,000	,,	Oct. 18	†7	†9	Oriental, Ltd....	153—158	...	157
468,537	,,	June 7	8	8	Plymouth & Stonehouse 5 p.c.	157—162	...	...
621,667	,,	Aug. 9	8¼	8¼	Portsmouth & Gosport Cons.	164—169	...	...
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	104—109	...	...
73,350	,,	,,	5	5	Do. 5 p.c. Pref. ...	110—115	...	...
441,275	1	Sept. 20	1/1⅛	1/1⅛	Severn Val. Gas Cor. Ld. Ord.	21/6—23/6	...	...
460,810	1	,,	-/10⅛	-/10⅛	,, ,, 4½ p.c. Cum. Pref.	19/6—21/6	...	...
133,201	Stk.	Aug. 23	5	8½	Shrewsbury 5 p.c. Ord. ...	130—135	...	133½
1,371,752	1	Sept. 6	1/2⅝	1/2⅝	South East'n Gas. Cn.Ld. Ord.	23—25/-	...	23/9—23/10½
871,636	1	,,	-/10⅝	-/10⅝	Do. 4½ p.c Red. Cum. Pref.	20—22/-	...	20/6
498,818	1	,,	4	4	Do. 4 p.c. Cum. Pref. ...	18—20/-	...	...
450,000	Stk.	Aug 9	4	4	Do. 4 p.c. Deb.	99—102	...	...
150,000	,,	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	96—99	...	...
6,709,895	,,	Aug.	6	5	South Met. Ord.	101¼—103½	½	102½—103
1,135,812	,,	,,	6	6	Do. 6 p.c Irred. Pf. ...	131—136	...	...
850,000	,,	,,	4	4	Do. 4 p.c. Irred. Pf. ...	98—101	...	100¼
1,895,445	,,	June 21	3	3	Do. 3 p.c. Deb. ...	75—80	...	78—78½
1,000,000	,,	July 5	...	5	Do. 5 p.c. Red. Deb....	110—113	...	...
1,543,795	,,	Aug 9	6	6	South Suburban Ord 5 p.c....	120—125	...	124—124
512,825	,,	,,	5	5	Do. 5 p.c. Pref...	110—115	...	114
500,000	,,	,,	4	4	Do. 4 p.c. Pref.	95—100	...	...
250,000	,,	,,	...	§18/9	Do. 3½ p.c. Red. Pref.	98—101	...	...
888,587	,,	June 7	5	5	Do. 5 p.c. Deb....	115—120	...	116
250,000	,,	,,	4	4	Do. 4 p.c. Deb....	98—101	...	...
200,000	,,	Sept. 20	...	3½	Do. 3½ p.c. Red. Deb.	94—59	...	98
427,859	1	Nov. 1	1/2⅜	9⅜	S. Western Gas & Water Ord.	18⅛—20⅛	...	...
160,523	1	,,	-/10⅛	-/10⅛	Do. 4 p.c. Red. Cum. Pf.	19⅛—21⅛	...	...
110,000	Stk.	June 21	4	4	Do. 4 p.c. Red. Deb. ...	97—102	...	...
750,541	,,	Aug. 9	5⅛	5	Southampton Ord. 5 p.c. ...	111—116	...	...
148,836	,,	June 7	4	4	Do. 4 p.c. Deb.	97—102	...	...
350,000	,,	Aug. 23	5½	5½	Swansea 5½ p.c. Red. Pref. ...	110—115	...	...
94,000	,,	June 7	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100	...	...
1,076,490	,,	Aug. 9	6⅔	6⅔	Tottenham and District Ord.	132—137	−1	...
409,835	,,	,,	5⅝	5⅝	Do. 5½ p.c. Pref....	121—126	...	...
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	110—115	...	...
†371,850	,,	June 7	4	4	Do. 4 p.c. Deb. ...	97—102	...	99½—100½
888,629	1	Oct. 4	6	4	U. Kingdom Gas Cor. Ord.	20/—22/-	...	20/—20/9
937,743	1	Nov. 15	4½	4½	Do. 4½ p.c. 1st Cum. Pref.	20/—22/-	...	20/-
745,263	1	June 7	4½	4½	Do. 4½ p.c. 2nd Non-Cum. Pf.	17/—19/-	...	17/9—18/9
1,000,000	Stk.	Sept. 20	3⅜	3⅜	Do. 3½ p.c. Red. Deb. ...	96—99	...	97⅜
373,939	,,	Aug. 9	7	7	Uxbridge, &c., 5 p.c. ...	140—145	...	...
133,010	,,	,,	5	5	Do. 5 p.c. Pref. ...	109—114	...	110
1,371,138	,,	Aug. 9	7	7	Wandsworth Consolidated ...	140—145	...	142—143
2,525,768	,,	,,	4	4	Do. 4 p.c. Pref. ...	99—102	...	99½—101½
1,343,964	,,	June 7	5	5	Do. 5 p.c. Deb. ...	115—120	...	116—118½
383,745	,,	,,	4	4	Do. 4 p.c. Deb. ...	97—102	...	...
558,342	,,	Aug. 9	7	7	Watford and St. Albans Ord.	140—145	+2	142—144½
200,000	,,	,,	5	5	Do. 5 p.c. Pref. ...	109—114	...	...
200,000	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	121—126	...	...
200,000	,,	Nov. 29	4	4	Do. 4 p.c. Red. Deb.	95—100*	−2	...
100,000	,,	,,	3½	3½	Do. 3½ p.c. Red.Deb.	94—99*	−1	...

a.—The quotation is per £1 of Stock * Ex div. † Paid free of income-tax. ‡ For year. § Actual.

Stock and Share List continued overleaf.

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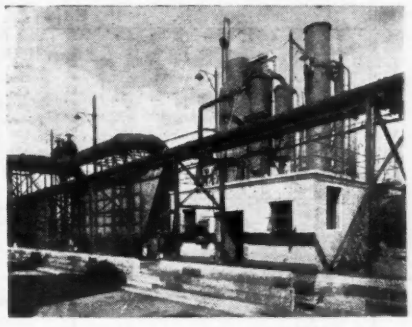

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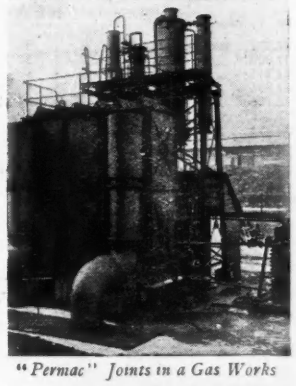

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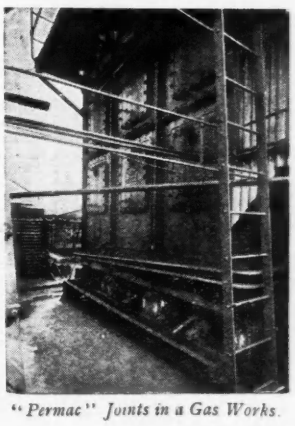

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Stocks Officially Quoted on Provincial Exchanges

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. Dec. 3	Rise or Fall on Week.	Transactions Lowest and Highest During the Week.
BRISTOL EXCHANGE.								
347,756	Stk.	July 19	6	5	Bath Cons.	120—122	...	...
1,667,250	,,	July 19	5	5	Bristol, 5 p.c. max.	116—117	+½	...
120,420	,,	June 7	4	4	Do. 1st 4 p.c. Deb. ...	100½—102½	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	100½—102½	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	120—123	...	...
274,000	,,	July 19	5	5	Newport (Mon.) 5 p.c.max. ...	100—105	—1	...
13,200	12	Sept. 6	8	7	Pontyp'l Gas & W. 10 p.c. 'A'	13—14	...	...
13,600	10	,,	6	5	Do. 7 p.c. 'B'	11⅞—12⅛	...	...
40,000	10	,,	6	5	Do. 7 p.c. 'C'	11⅞—12⅛	...	...
140,778	Stk.	Aug. 9	5	5	Weston-super-Mare Cons. ...	110—112	...	...
64,338	,,	June 21	4	4	Do. 4 p.c. Deb.	96—98	...	...
33,340	,,	,,	7½	7½	Do. 7½ p.c. Deb.	157—160	...	...
LIVERPOOL EXCHANGE.								
157,150	Stk.	Aug. 9	6½	5	Chester 5 p.c. Ord.	104—109	...	...
92,500	,,	June 21	4	4	Do. 4 p.c. Pref.	97—101	...	
36,430	,,	,,	3½	3½	Do. 3½ p.c. Deb.	89—92	...	...
41,890	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	98—102	...	...
2,167,410	,,	Aug. 23	6	6	Liverpool 5 p.c. Ord.	125½—127½	...	...
245,500	,,	June 21	5	5	Do. 5 p.c. Red. Pref. ...	99—104	...	...
306,083	,,	July 1	4	4	Do. 4 p.c. Deb. ...	102—104	...	...
106,280	,,	Aug. 9	10	10	Preston 'A' 10 p.c.	206—216	...	...
188,219	,,	,,	7	7	Do. 'B' 7 p.c.	147—157	...	...
NEWCASTLE EXCHANGE.								
122,577	Stk.	Aug. 9	8	8	Blyth 5 p.c. Ord.	165—166	...	...
732,000	,,	Aug. 9	5	5	Hartlepool G. & W. Cn. & New	112—114	—5	...
2,061,315	,,	Aug. 9	5⅝	5	Newcastle & Gateshead Con.	23/—23/6d	...	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	98—100	...	...
776,706	,,	June 21	3½	3½	Do. 3½ p.c. Deb. ...	90½—91½	...	...
277,285	,,	Nov. 1	5	5	Do. 5 p.c. Deb. '43...	103—105	...	...
332,351	,,	Aug. 23	6	6	Sunderland 6 p.c. max. ...	139—141	...	...
NOTTINGHAM EXCHANGE.								
542,270	Stk.	Aug. 9	9	6	Derby Con.	135—145	...	...
55,000	,,	June 7	4	4	Do. 4 p.c. Deb.	100—105	...	...
20,000	10	June 7	5	5	Long Eaton 5 p.c. Pref. ...	10—12	...	...
80,000	Stk.	,,	5	5	Do. 5 p.c. Deb. ...	105—110	...	...
SHEFFIELD EXCHANGE.								
10,000	Stk.	Sept. 20	10	10	Great Grimsby 'A' Ord. ...	210—220	...	...
6,500	,,	,,	10	10	Do. 'B' Ord. ...	210—220	...	...
79,000	,,	,,	10	10	Do. 'C' Ord. ...	205—210	...	...
1,806,339	,,	Aug. 23	6	6½	Sheffield Cons.	144—148	...	...
95,000	,,	July 5	4	4	Do. 4 p.c. Deb.	100—103	...	...
Supplementary List of Stocks and Shares not Officially Quoted								
202,152	Stk.	Sept. 6	25/-b	5	Ascot Ord.	100—105	...	...
128,182	,,	July 5	5	5	Do. 5 p.c. Pref.	108—113	...	...
573,156	1	Nov. 15	5	5	Assd. Gas and Water Ord. ...	19/—21/-	...	...
167,506	1	,,	...	-/4c	Do. 4 p.c. Red. Cum. Pref.	19/—20/-	...	...
253,118	1	,,	...	4	Do. 4 p.c. Irred Pref. ...	18/—20/-	...	...
500,000	1	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	19/—21/-	...	...
500,000	Stk.	Sept. 6	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100	...	...
31,035	1	Aug. 23	...	-/4½	Associated Utilities 4 p.c. Pref.	16/6—18/6	...	...
100,000	Stk.	...	...	...	Do. 3½ p.c. Red. Deb.	95—100	...	...
17,000	,,	Aug. 23	8	8	Bognor Orig. Ord. 'A' ...	160—170	...	...
62,210	,,	,,	8	8	Do. New Addl. 'A' ...	160—170	...	...
87,160	,,	,,	7	7	Do. New 7 p.c. max. ...	141—146	...	...
37,440	,,	Aug. 9	10	10	Cam. Univ. & Town 10 p.c.max.	193—203	...	...
125,970	,,	,,	7	7	Do. 7 p.c. max.	135—140	...	...
39,025	,,	,,	5	5	Do. 5 p.c. max.	98—103	...	...
65,000	,,	Aug. 9	8½	7½	Eastbourne 'A' 5 p.c. ...	158—163	...	...
198,000	,,	,,	7	6	Do. 'B' 3½ p.c.	128—133	...	129
112,312	,,	,,	5	5	Do. 5 p.c. Pref.	108—113	...	...
130,000	,,	June 21	5	5	Do. 5 p.c. Deb.	115—120	...	...
24,000	30	Aug. 23	8½	8½	Great Yarmouth 8½ p.c. max.	44—49	...	...
59,400	30	,,	7½	7½	Do. 7½ p.c. max.	34—39	...	...
51,160	Stk.	June 7	5½	5½	Do. 5½ p.c. Deb.	120—125	...	...
152,600	,,	Sept. 6	9	8	Guildford Cons.	170—175	...	...
54,055	,,	,,	5	5	Do. 5 p.c. Pref.	110—115	...	...
68,250	,,	June 7	5	5	Do. 5 p.c. Deb.	113—118	...	...
156,600	,,	Aug. 23	7½	7½	Hampton Court Cons. ...	158—163	...	...
73,620	,,	Sept. 6	8½	8½	Luton Cons. 'A'	163—168	...	...
107,960	10	Sept. 20	5½	4	Mid Kent Ord.	8¼—9¾	...	...
230,940	Stk.	Aug. 9	10	10	Oxford & District Ord. ...	205—210	...	...
47,112	,,	,,	5	5	Do. 5 p.c. Pref.	108—113	...	...
50,000	,,	,,	6	6	Do. 6 p.c. Red. Pref. ...	110—115	...	...
126,193	,,	Nov. 15	7½	7½	Peterborough Ord.	158—163	...	...
64,990	,,	Sept. 6	7½	6½	Redditch Ord.	125—135	...	...
166,850	,,	Aug. 9	8	8	Romford Ord.	155—165	...	...
60,000	,,	,,	4	4	Do. 4 p.c. Pref.	97—100	...	...
44,000	,,	Sept. 20	5	5	Do. 5 p.c. Deb.	113—118	...	...
25,570	,,	Aug. 9	5½	5½	Rugby 5½ p.c. Pref.	125—130	...	...
25,000	,,	,,	6	6	Do. 6 p.c. Red. Pref. ...	106—111	...	...
42,750	,,	June 7	5½	5½	Do. 5½ p.c. Deb.	122—127	...	...
10,950	,,	Aug. 23	8	8	Ryde Ord.	158—163	...	...
270,086	,,	Sept. 6	7	7	Slough Ord.	135—140	...	...
21,000	,,	June 21	5	5	Do. 5 p.c. Deb.... ...	112—117	...	...
28,872	1	Nov. 1	5½	5½	S. Midland Gas Cpn. Ltd. Ord.	19/—21/-	...	...
28,866	1	Sept. 6	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	18/6—20/6	...	...
137,730	Stk.	Aug. 9	7	7	Southgate & Dist. 7 p.c. max.	140—145	...	...
62,500	,,	,,	5	5	Do. 5 p.c. Pref.	110—115	...	...
117,228	,,	Aug. 23	5	5	Swindon Cons.	106—111	...	...
60,425	,,	June 7	5	5	Do. 5 p.c. Deb.... ...	110—115	...	...
64,380	,,	June 7	5	5	Torquay and Paignton 5 p.c. Pf	110—115	...	...
500,000	1	Nov. 15	...	-·1·15c	United Kingdom Gas Corpn. 4 p.c. 1st Red. Cum. Pref.	19/—21/-	...	20/-
33,858	1	,,	...	-/2·70c	Do. 4½ p.c. 1st. Cum Pref.	20/—22/-	...	19/6
130,000	Stk.	Aug. 9	8	5	Wakefield Ord.	120—125	...	...
81,650	,,	,,	5	5	Do. 5 p.c. max.	103—108	...	...
82,000	,,	Aug.	6	6	Weymouth Ord.	103—108	...	...
98,384	,,	Aug. 9	6	6	Wolverhampton 6 p.c. Pref....	120—125	...	...
160,000	,,	June 21	5½	5½	Do. 5½ p.c. Rd. Db	108—113	...	...
90,000	,,	June 21	5	5	York 5 p.c. Red. Deb. ...	105—110	...	...
133,640	,,	July 19	6½	6½	Yorktown (Cam.) 5 p.c Cons.	128—133	...	...
120,000	,,	,,	5	5	Do. 5 p.c. Pref.	108—113	...	...
35,000	,,	June 7	5½	5½	Do. 5½ p.c. Deb.	123—128	...	

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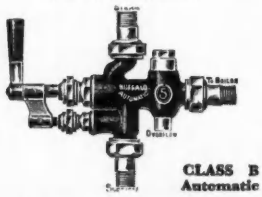

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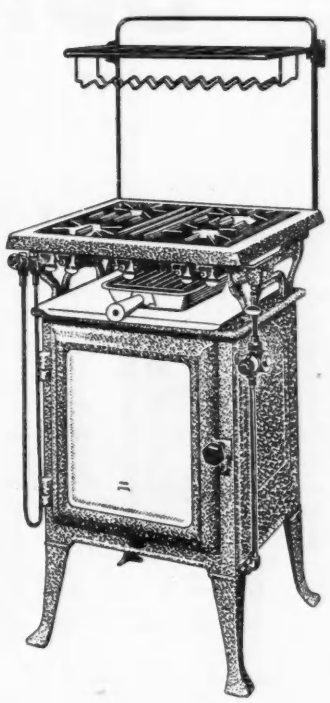

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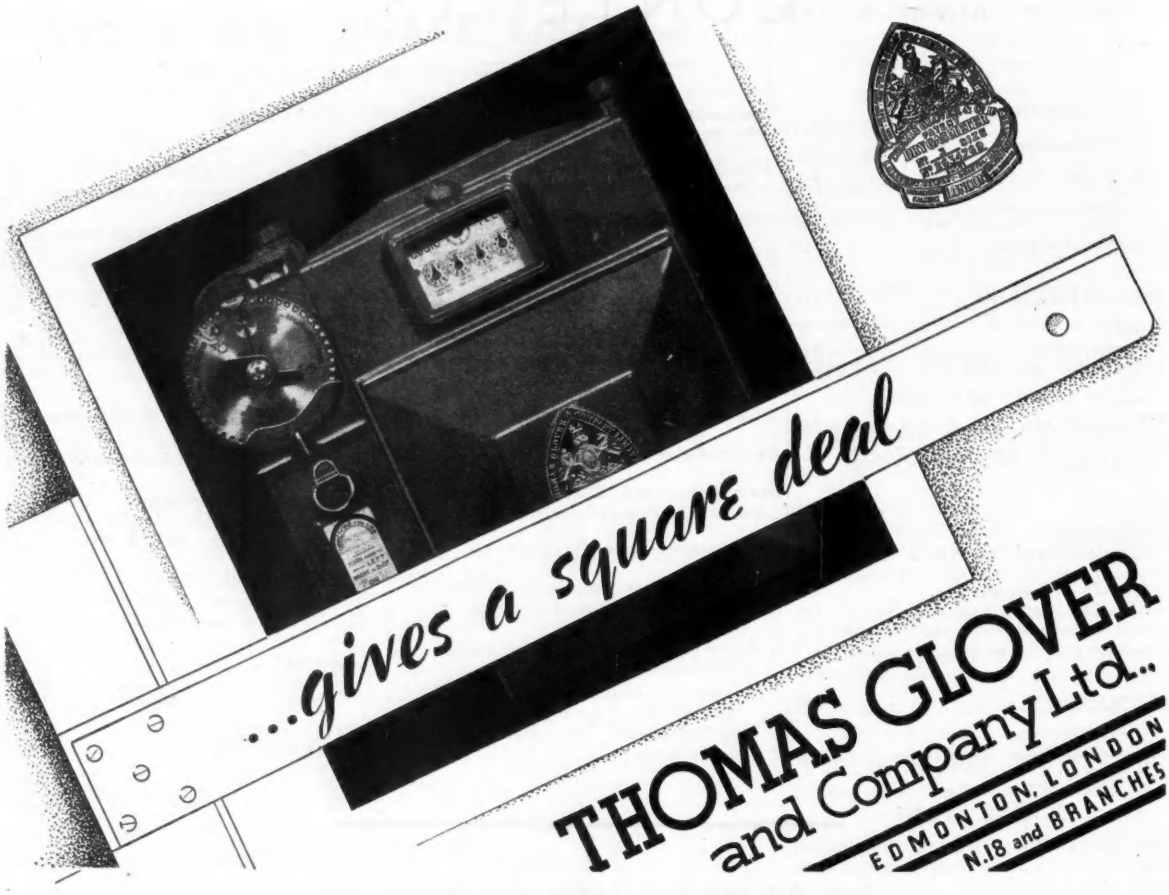

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